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ADDITIONAL NOTES ON HEREDITY AND LIFE HISTORY IN THE COCCINELLID GENUS ADALIA MULSANT.

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In 1911 an article was published by the writer in the Annals of the Ent. Soc. of America, entitled "Some Notes on Heredity in the Coccinellid Genus *Adalia* Muls." This paper comprised all of the forms of Adalia at that time known to the writer to have been taken in Colo., viz., *melanopleura* Lec., *annectans Crotch, coloradensis* Casey, and *humeralis* Say. These forms were all found to interbreed freely, the different types acting as Mendelian units. In the spring of 1916 experiments were begun for the purpose of determining the biological relation between these forms and *A. bipunctata* Linn.

Adalia bipunctata Linn. as dealt with in this paper may be described as follows: Head black, with two white spots bordering the eyes. Pronotum pale with black M-shaped design with the broad pale margins, except in rare cases, immaculate instead of the black lateral dot as in *A. annectans*. Elytra brownish red with a rather large rounded black spot in the center of each. Legs black or brownish black. Length 4–5.5 mm., width 3.5–4 mm.

The appearance of the egg and larva in all stages seems indistinguishable from the rest of the *Adalia* group studied.* The color of the egg varied from pale lemon yellow to strong orange. This difference of color seemed to have no real significance, as eggs of both colors were laid by the same female and

*See Annals Ent. Soc. of America. Vol. VII, 1914, p. 228.

sometimes, in the same patch. The orange colored eggs seemed usually to be confined to the first egg patches laid by a female. Length of eggs was about 1.1–1.2 mm.

In the spring of 1916, through the kindness of Prof. R. L. Webster, two shipments of live *A. bipunctata* Linn were received from Ames, Iowa, March 21st and April 1st respectively, seven beetles in each shipment. Later about a dozen of this species were found in Colorado by Mr. L. C. Bragg, and Prof. C. P. Gillette. Owing to the unusual scarcity of the native species only a few of these were secured for the making of the crosses.

The first shipment from Iowa consisted of 6 unfertilized females and one male, the second 5 unfertilized females and 2 males. An *annectans* male was secured and introduced to each of these females. Though they readily mated, in only one instance did it seem to have any result. The eggs either continued to be infertile, or, if the female was already fertilized by a *bipunctata* male, the progeny continued typical *bipunctata*, though they were reared to the second generation.

A large number of beetles were reared from these females, mated with *bipunctata* males, in order to determine whether they were pure strains and what variation might appear. From one of these pairs (Figure 1), 54 beetles were reared in the first generation, all exactly resembling the father and mother, and 71 in the second generation, all true to type except 3, one of which was smaller spotted and two which possessed the lateral dot and lacked the basal white on the pronotum, and had the elytral spots ragged in outline with a slight projection or dot mesad and surrounded by a yellowish halo. From another of these females (Figure 2) mated with the same male there were produced in the first generation 23 beetles exactly resembling the parents, in the second generation, 16 beetles showing exactly the same characters. Another female (Figure 3) with the same male as above produced in the first generation 18 beetles, all normal. Another *bipunctata* female with a *bipunctata* male (Figure 4) produced 39 beetles in the first generation, all true to type, and 15 in the second generation, also true. A number of the first generation from this beetle were put with a number of the first generation from the first mentioned beetle (Fig. 1) and 11 beetles resulted, all apparently typical

bipunctata. Still another pair of these beetles (Fig. 5) produced in the first generation 9 beetles like the parents excepting that 2 have slightly smaller spots, in the second generation 4 beetles all typical.

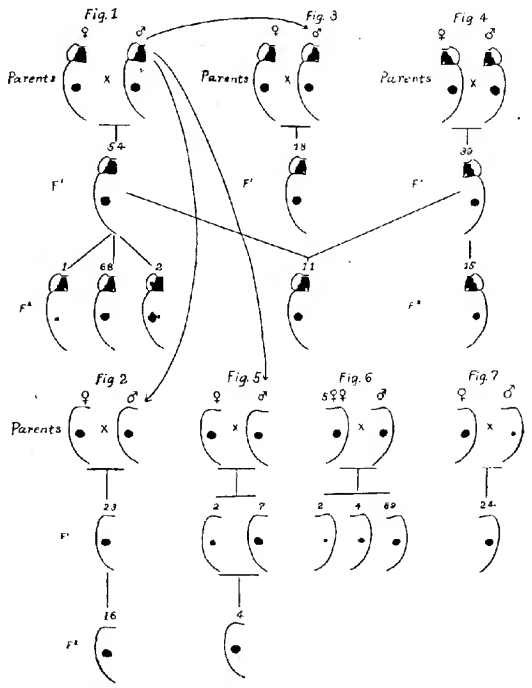

Fig. 1. Pair of *bipunctata* beetles, from Iowa, and their progeny.
Fig. 2. Pair of *bipunctata* beetles, from Iowa, and their progeny. (Male same as Fig. 1.)
Fig. 3. Pair of *bipunctata* beetles, from Iowa, and their progeny. (Male same as Fig. 1.)
Fig. 4. Pair of *bipunctata* beetles, from Iowa, and their progeny.
Fig. 5. Pair of *bipunctata* beetles, from Iowa, and their progeny.
Fig. 6. Five *bipunctata* females and 1 male, from Iowa, and their progeny.
Fig. 7. One female from Fig. 6 mated with a *bipunctata* male, from Colorado, and progeny.

One of these *bipunctata* females (Figure 8) previously unfertilized, mated with the same *annectans* male, as had been offered without result to the above females, produced in the first generation 3 *bipunctata* beetles with moderately small

spots. One of these, a female, was mated with its *annectans* father and produced 3 small-spotted *bipunctata* and 2 typical *annectans*. Another of this lot of first generation females was mated with an *annectans* male from out of doors (Figure 9) and the first egg patch resulted in 3 *bipunctata*, 2 fairly small-spotted and one with a dot mesad of the elytral spots. The second egg patch gave 1 *bipunctata* normal, 1 *bipunctata* with spots reduced to dots, and 1 *annectans*. The original female (Figure 8) was then mated with a small-spotted *bipunctata* male (Figure 11) and 16 large-spotted *bipunctata* resulted.

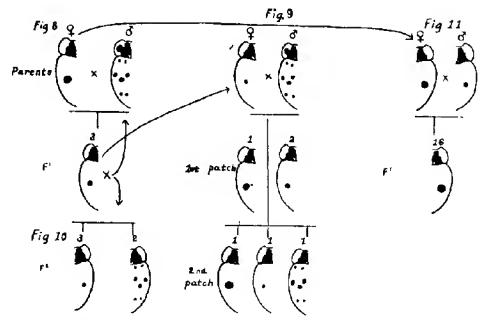

Fig. 8. *Bipunctata* female from Iowa mated with *annectans* male, and progeny.
Fig. 9. Female of F^1. generation of Fig. 8 mated with *annectans* male, and progeny.
Fig. 10. Female of F^1. generation of Fig. 8 mated with *annectans* male (father).
Fig. 11. *Bipunctata* female of Fig. 8 mated with *bipunctata* male from Colorado.

The 5 other females from Iowa were put together in one cage with a *bipunctata* male (Figure 6) and from the eggs 95 beetles were reared, all *bipunctata*, 2 small-spotted, 4 medium-spotted, and the rest of the same size of spots as the parents. One of the females was separately mated with a *bipunctata* male with small spots (Figure 7), and there resulted 24 *bipunctata* with spots the same size as the mother.

From the *bipunctata* beetles taken in Colorado there were also a considerable number of beetles reared. These were taken in Denver on two occasions, ten on April 19th by Mr. L. C. Bragg, and three on April 28 by Prof. C. P. Gillette. The first lot consisted of 6 females and 4 males and the second lot were all males and small-spotted. From one female (Fig. 12) mated with a *bipunctata* male 29 beetles were reared in the first generation, all apparently normal except that one was smaller-

spotted, and 6 in the second generation, all apparently normal *bipunctata*. Another female (Figure 13) mated with a *bipunctata* male produced in the first generation 11 beetles, 4 with spots the same size as the parents and 7 smaller-spotted and in the second generation 16 beetles like the grand-parents.

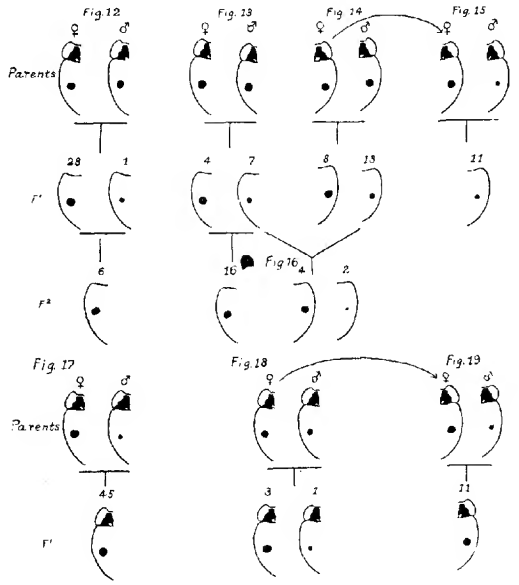

Fig. 12. Pair of *bipunctata* beetles from Colorado, and progeny.
Fig. 13. Pair of *bipunctata* beetles from Colorado, and progeny.
Fig. 14. Pair of *bipunctata* beetles from Colorado, and progeny.
Fig. 15. Pair of *bipunctata* beetles from Colorado, and progeny, (female the same as Fig. 14).
Fig. 16. Progeny of F_1 or F_1 of Fig. 13 and 14.
Fig. 17. Pair of *bipunctata* beetles, from Colorado, and progeny.
Fig. 18. Pair of *bipunctata* beetles, from Colorado, and progeny.
Fig. 19. Pair of *bipunctata* beetles, from Colorado, and progeny, (female the same as Fig. 18).

Another female (Figure 14) mated with a large-spotted male produced in the first generation 21 beetles, 13 more or less small-spotted and 8 fairly large-spotted. This female was then mated with a small-spotted male (Figure 15) from Denver and from this union 11 *bipunctata* were produced, all rather small-spotted. From a cage containing the small-

spotted beetles of the first generation of the last two females (Figures 13 and 14) eggs were reared (Figure 16) which resulted in 6 *bipunctata*, 2 of which had *very* small spots. From another pair (Figure 17) there were reared 45 large-spotted *bipunctata* in the first generation. Another of these females, (Figure 18) mated with a *bipunctata* male medium-spotted, produced *4 bipunctata*, 3 normal and one rather small-spotted; mated later (Figure 19) with a small-spotted *bipunctata* male it produced 11 beetles, all with good-sized spots.

All of these *bipunctata* beetles were evidently pure strains, as no other forms appeared in the progeny though large numbers were reared and most were carried through the second generation. The size of the spots evidently varies and seems to act merely as a fluctuating variation, though it appeared oftener in some strains than in others. It probably acts the same as the size of the spots in *annectans* discussed in the former paper of 1911. The marking on the pronotum, too, seems to vary so that the white lateral area may be broken into (Figure 1), so as to form the black lateral dot.

In the early part of May an *annectans* female (Figure 20) was taken on the campus and soon laid a patch of eggs, fertilized before capture. From this egg patch there developed 16 beetles, viz., 3 *annectans*, 4 *melanopleura* with white area on the pronotum, 2 *melanopleura*, normal, with lateral dot on the pronotum, 4 *bipunctata* with very small spots, and 3 *coloradensis* with considerable variation, 2 with the typical white area on the pronotum and one with it broken by a black lateral dot, more posteriorly placed than in *annectans*. A few second generation individuals were reared from most of these forms. The *annectans* beetles produced 1 *annectans*. The *melanopleura* with white area mated with each other, produced 3 normal *melanopleura* with lateral dot; one of the males mated with an *annectans* female produced 4 beetles, 2 *annectans* and 2 normal *melanopleura* with lateral dot. These results seem to signify that the lack of the lateral dot may occur in *melanopleura* as a fluctuating variation, as these specimens could not have been influenced by the other element of the hybrid as they were either *annectans* or else *humeralis* hybrids, both of which have always proved to be recessive to every character of *melanopleura*.

The bipunctata specimens produced 1 *annectans* and 1 *humeralis*, which signifies that there were two kinds of *bipunctata* hybrids, viz., both *annectans* and *humeralis*. One pair of *coloradensis* specimens, one with white area and one with

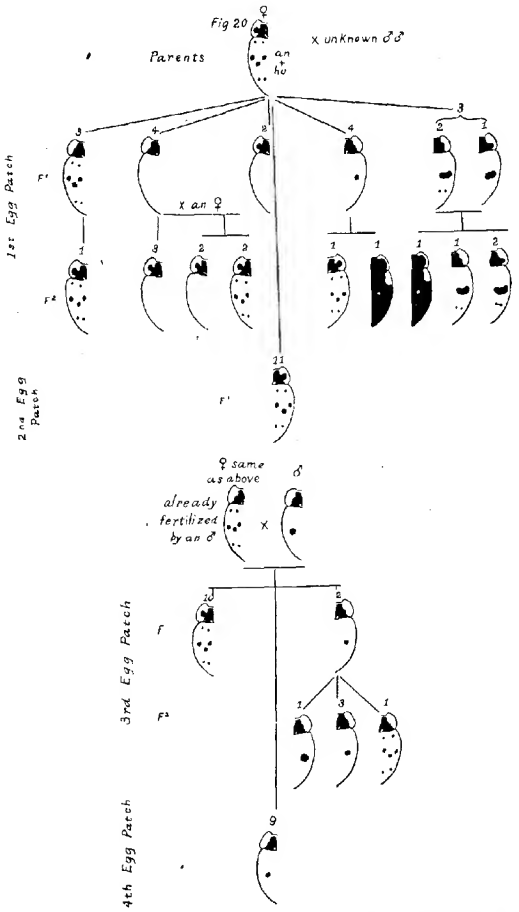

Fig. 20. *Annectans* female captured out doors, already fertilized, and progeny, 3rd and 4th egg patches laid after fertilization of the female by a *bipunctata* male taken in Colorado.

posterior lateral dot, produced 4 beetles, 1 *humeralis* and 3 *coloradensis;* 1 of the latter with white area and 2 with posterio-lateral dot. This dot seems in this case to be a fluctuating variation, for the appearance of the *humeralis* in the progeny proves the parents both to have been *coloradensis* hybrids with *humeralis;* in other words, each presented a single strain of *coloradensis* and neither one seems to be a Mendelian dominant. Evidently from these last two cases, the *annectans* mother of all these must have been an *annectnas humeralis* hybrid and must have been mated with several males very nearly at the same time. These males must have born *annectans, melanopleura, bipunctata and coloradensis.*

After 9 days the above female laid another patch of eggs from which 11 beetles were reared, all *annectans,* which seems to signify that the *annectans* male was the last one which mated with the female and the most of the eggs in the first patch had already been fertilized by the former males. The second patch, however, was fertilized entirely by the *annectans* male, the fresher spermatozoa evidently taking precedence over the older ones.

This female was then mated with a *bipunctata* male and the next egg patch, laid within 3 or 4 days produced in the first generation 10 *annectans* and 2 *bipunctata* with small spots, in the second generation from the *bipunctata* beetles there were reared 1 normal *bipunctata,* 3 with fairly small spots and one *annectans.*

A fourth patch of eggs laid 6 days later was reared and 9 beetles matured, all *bipunctata* with small spots. These beetles emerged during the latter part of June, but up to the 15th of August, when the experiment was discontinued, they had neither laid any eggs nor been seen in copulation. They were, however, seemingly in perfectly healthy condition and probably would have hibernated and laid in the spring, or they might have begun breeding September 1st. The latter supposition is based on the theory that the inactivity may have been due to the period of cessation during July and August mentioned by D. E. Fink in his bulletin 1915 of the Virginia Experiment Station. A period of great difficulty in rearing *Coccinellids* at this season of the year has been noted in Colorado by the writer, but has been heretofore attributed rather unsatisfactorily to various other causes.

In this case every one of the forms under consideration appeared from the eggs of a single female, but hybrids of *bipunctata* were discovered only with *annectans* and *humeralis*.

On the 25th of May an egg patch was obtained from another *annectans* female (Figure 21), taken out of doors already fertilized. Though, for 5 days before laying the eggs, it had been mated with a *bipunctata* male, the one used in Figure 1, 2, 3, and 5, no trace of *bipunctata* appeared in the progeny. Thirteen beetles matured, 3 *annectans*, 4 normal *melanopleura* with lateral dot, 3 *melanopleura* with white area, and 3 *coloradensis* with a lateral dot placed more posteriorly than the

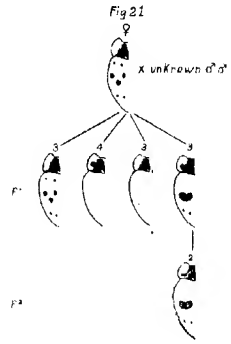

Fig. 21. *Annectans* female captured, already fertilized, and progeny.

lateral dot of the other forms. In the second generation from the *coloradensis* cage, 2 beetles were reared and they were both *coloradensis* with the posterior lateral dot.

Judging from this case together with the similar results with the *coloradensis* progeny of the former *annectans* female, it is evident that *coloradensis* often possess a lateral dot, more posteriorly placed than in other forms, instead of the broad white area as given in the former paper of 1911. Both these patterns are mentioned in the original description by Casey. The above-mentioned lateral dot seems in this case to have bred true, but considered with the case in Figure 20 it can hardly be considered more than a fluctuating variation, since in that case a pair of *coloradensis humeralis* hybrids, one with the dot and one with the white area produced progeny both with and without the dot.

Conclusions: (1) *Bipunctata-annectans* hybrids were formed both in the laboratory and in state of nature. More difficulty was experienced, however, in securing crosses than in the previous experiments with only the native forms, but this may have been partly accidental. They would mate readily enough, but in only comparatively few instances were the eggs affected. The hybrids when formed seemed just as healthy and fertile as the other hybrids.

(2) *Bipunctata-humeralis* hybrids were formed out of doors and these, too, were fertile.

(3) The appearance of the *bipunctata-annectans* and the *bipunctata-humeralis* hybrids was identical in these cases. *Bipunctata* dominated completely in the markings of the pronotum and also in the spots of the elytra unless the smaller size of the spots was a modification. The spots were no smaller though than those that occasionally appeared in what seemed to be pure strains of *bipunctata*. Evidently in the *bipunctata-annectans* hybrid the size of the spot is determined by the marking of the smaller spotted parent, black being recessive in these beetles (see paper of 1911). Except in rare cases the smaller spotted parent is most liable to be *annectans*. Since *bipunctata* seems to be small spotted in some cases there is no constantly reliable character whereby to distinguish the hybrid except that it is very likely to be more or less small-spotted.

Why the size of the spot should be reduced in the *bipunctata-humeralis* hybrids is far from clear. In these experiments it could hardly have been due to mere fluctuation of the *bipunctata* element or the results would not have been so constant. For example: In the case of Figure 20, first, third and fourth egg patches 15 hybrids were obtained from the *annectans-humeralis* female crossed with a *bipunctata* male. The chances are that half of these were *bipunctata-annectans* and half were *bipunctata-humeralis* hybrids, which should be enough to show some variation, but the dot seems to be of practically uniform size in all.

(4) *Bipunctata*, in the hybrid form, was reared from the same patch of eggs as were also *melanopleura* and *coloradensis*, and this seems very good if not indeed, conclusive evidence that they are able to interbreed with these forms too, though the exact hybrids were not all produced.

(5) In *melanopleura*, *coloradensis* and *bipunctata* there were discovered variations in the markings of the pronotum, viz.: in all these forms the lateral dot may be either present or absent. So *melanopleura* with the white area on the pronotum are not necessarily *melanopleura-coloradensis* hybrids as supposed in the paper of 1911 or *melanopleura-bipunctata*, as might be expected. Vice versa, since *bipunctata* sometimes possess the lateral dot it would not be surprising to find *melanopleura-bipunctata* hybrids bearing it and so not differing in appearance from typical *melanopleura*. The lateral dot in *coloradensis* being differently placed and not coinciding with the regular dot, the white area would be expected to appear in the hybrid.

In *melanopleura* the presence of the lateral dot is infinitely the more common form, in *coloradensis* it seems to be rather uncommon, and in *bipunctata* it is extremely rare.

In 1914 a second article was published by the writer in the Annals of the Ent. Soc. of Am. entitled "Some Notes on Life History of Ladybeetles." As the writer had not then taken *bipunctata* in Colorado, it was not included in those experiments. In order to complete this record a few life history notes were taken on this species in connection with the foregoing experiments.

Life cycle records were taken as follows:

Egg stage (6 records) 3–7 days.
Larva stage (2 records) 9–10 days (in hot weather).
Pupa stage (2 records) 4–5 days (in hot weather).
Egg to adult 16–30 days.

Adult stage; no records taken except on hibernating beetles, a number of which lived and mated and laid eggs in the laboratory until August 15, when the experiment was discontinued and they were killed and pinned up. Judging from this the hibernating form must be able to live 12 months more or less. The life cycle records vary greatly according to the temperature of the weather. In the spring each stage took about twice as long as in the warmest part of the summer with the thermometer from 87 to 93 degrees.

One satisfactory egg record was taken and in 3 months and 15 days this female laid 1,180 eggs. The beetles laid from 12 to 35 eggs in a patch and would sometimes lay 2 patches a day and would also often skip several days and then lay again.

Before being fertilized the beetles would lay only a few scattered eggs but in a day or so thereafter they would lay plentifully and in good patches. Fertilization seemed to last several weeks, but not for the season. One female observed was found to be laying infertile eggs 35 days after being isolated from a male. The spermatozoa of the later male seem always to take precedence over all former, so that the eggs which have not been already fertilized produce the characters of the last male. The earliest egg patch was obtained April 1st and the earliest beetles emerged May 1st.

A few feeding records were taken on both *bipunctata-annectans* and *annectans* larvae. These were taken in very warm weather, the thermometer being 87° to 93° each day. The larvae, accordingly ate their maximum and finished their life cycle in the minimum time. In colder weather they ate much less per day and the period of development was according prolonged. These experiments were conducted with the greatest care. The larvae were put into separate cages and the lice which were given for feed were counted as carefully as possible. Young of *Myzus circumflexus* were used for the first feed in each instance and after that *Chaitophorus negundinis* was used entirely. A check tube was kept to ascertain the number of lice dying naturally in a day, but it seemed to be of little account, as practically no lice seemed to die except from some disease or from capsid injury, and this turned the dead bodies brown, so that they could be easily distinguished in the larval cages. Some of the larvae had already filled up on the unhatched eggs of their patch before isolation, which of course did not count in the food record, also whenever there was any doubt as to the number of lice eaten the smaller alternative was taken. The young lice that may have been born after being put in the cage were not regarded, as they would not increase the bulk materially. The only difference they could make would be to add to the number left over and subtracted, which would reduce the number in the record, instead of exaggerating it. In these ways every precaution was taken against getting too large a count. The records are as follows:

	June 29	30	1	2	3	4	5	6	7	8	Total	Length Larva	Length Adult
bi. larva	H	10	M 7	M 45	23	M 60	100	80	P		325	7 mm.	5 mm.
" "	H	5	M 8	M 30	50	M 95	92	100	30	P	407	6.9 mm	5 mm.
an. larva	H	5	M 8	M 43	M 18	84	72	4	P		234	7 mm.	4.9 mm.
" "	H	10	M 13	M 30	37	M 38	94	100	7	P	323	7 mm.	5 mm.
" "	H	2	M 16	M 23	M 46	67	75	0	P		243	7 mm.	4.5 mm.

H—hatched. M—molted. P—pupated. bi.—bipunctata. an—annectans.

The *bipunctata* specimens in this experiment were really *bipunctata annectans* hybrids.

The *annectans* larvae, it will be observed, have eaten less than the *bipunctata* individuals, but this is probably only accidental, as the larvae of the same species seem to vary greatly, and these specimens were all the same size, and should therefore be of equal capacity. It is interesting to notice that the one that ate the most lice was slightly the shortest when full grown.

These results seem to differ somewhat from those given by Mr. Clausen, in California, in his paper of 1916.* The difference is probably due to climatic conditions influencing the rapidity of development, as the totals, it will be seen, do not differ any more from these results than has been found as a common variation between individuals of the same species even under the same conditions. During the spring when the weather was cool the beetles ate much less per day and the life cycle periods were much longer. Though no counts were made at this time there is no doubt but that they would not disagree materially with the records of Mr. Clausen.

Perhaps the following observation on *Hippodamia convergens* might also be added. On July 18, 1916, this species was found by the writer congregated in heaps of hundreds in grassy crevices in the solid granite top of a foot-hill, 38 miles northwest of Ft. Collins, at an altitude of a little over 8,000 feet.

*Life-history and Feeding Records of a Series of California Coccinellidae by Curtis P. Clausen, University of California Publications, Technical Bulletins Entomology, Vol. I, No. 6, pp. 251-299, June 17, 1916.

Two other such cases were reported during the same summer and fall, about ten and fifteen miles from Ft. Collins, the one on the granite top of Horse Tooth Mountain, altitude 7,160 feet, and the other at about the same elevation. In the latter case the beetles were said to be massed on a small pine tree. Another mass was reported to have been found on a bare mountain-top west of Denver at about the same time of year as the former instances. In March, 1917, on the plains two miles west of Ft. Collins, Mr. L. C. Bragg observed hundreds of *convergens* coming out from hibernation from under rocks and stones near the road side.

THE NERVOUS SYSTEM OF THYSANURA.

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The central ganglia of representative genera, Campodea, Evalljapax, Lepisma and Machilis were examined.

The first important papers dealing with any of these genera were those of Grassi 1885 and 1888. In both of these, brief discussions of the nervous system are given, but no clear picture of the complete nervous system. Probably the most copied figure of the nervous system of any thysanuran is the one of Oudemans, 1887. In this, a drawing of the complete nervous system of Machilis is given which could hardly be improved upon, but the position of the optic lobes, brain and other cephalic parts are not shown in the relations we find them within the body of the animal. In this figure there is a representation of the fine medial nerve. Another paper by Grassi in 1888 shows the general form of the nervous system of Campodea and Japax and a number of details are clearly given. Bottger, 1910, on Lepisma saccharina L. gives a very complete account of the brain and shows it to be very nearly as complex as that of other insects.

Campodea undoubtedly has the most primitive, or at least, the simplest nervous system of any of these insects. The brain is provided with antennal nerves well towards the forward end. The first ventral ganglion is nearly under the brain, then there follow three large thoracic ganglia and seven small abdominal ganglia with the last one a little larger than the rest. This corresponds to Grassi's figure, but this one gives greater detail. It was drawn from gross dissection. No frontal ganglion is shown as one was not clearly recognized in section or dissection. (Figure 1).

Japax or Evalljapax in this case, differs quite a little from Campodea in appearance, the brain is of different shape, and as it is also without eyes, the forward antennal nerves are the most marked. The ventral ganglia are a little more oval, branches are more prominent and there is one more abdominal ganglion. The last abdominal as in Campodea, is a little larger

than the rest. The drawing is from a fresh, completely removed central nervous system. (Figure 2).

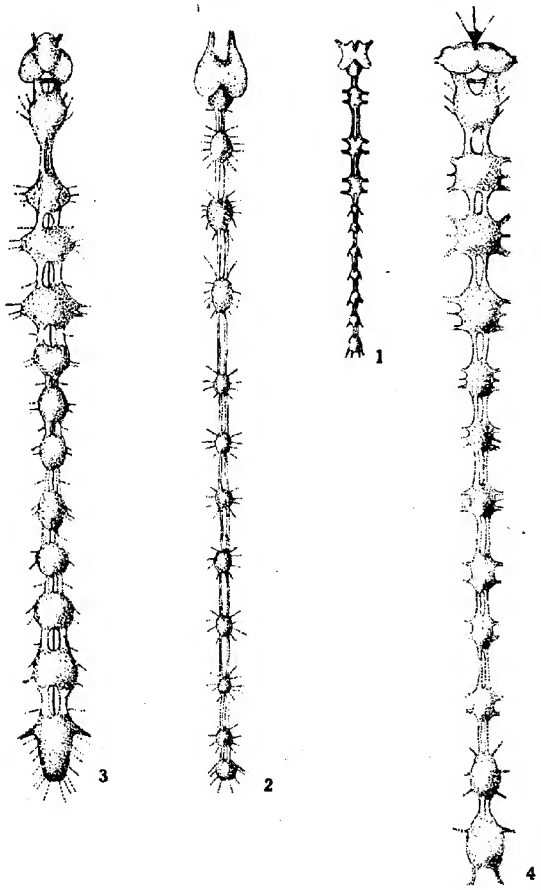

Fig. 1. Central nervous system of Campodea from above. × 10.
Fig. 2. Central nervous system of Evalljapax from above. × 10.
Fig. 3. Central nervous system of Machilis from above. × 10.
Fig. 4. Central nervous system of Lepisma from above. × 10.

Machilis has a more complicated brain, partly because of the eye connections; it also has a general transverse direction, as

shown in the figure and has quite a little depth. The frontal ganglion is not shown in the figure. The first ventral ganglion is large, so are the three thoracic ganglia. There are eight abdominal ganglia differing somewhat in size and somewhat from Oudemans figure. The median ventral nerve was found much as figured by Oudemans. Perhaps the most marked feature was in the backward extension of the optic lobe region because of the position of the eyes. The figure does not agree with Oudemans, largely because the brain is shown in its natural position as it is found in the head. (Figure 3).

Lepisma resembles Machilis very closely, but because of the more lateral and cephalic eyes the brain is more transverse when viewed from above. The frontal ganglion is shown in the figure. (Figure 4).

TRACHEAL DISTRIBUTION.

Trachea can be best studied by removing the ganglia and mounting while still fresh in glycerine. The air in the tracheal tubes remains for a few minutes and the distribution of the trachea may be seen. I found the tracheal distribution much as in the larva of another species. In general, the brain seems supplied by three main trachea on each side. The subesophageal ganglion by two main branches on each side, each ventral ganglion below this with one on each side, but the last ganglion with two branches at least, one of which often has some association with the branch of the next to the last ventral ganglion. Two branches seems to be the usual number for the last ganglion. (Figure 7-16).

It was very difficult to study trachea in the small Campodea because it was hard to remove the ganglia in the first place, and second because the trachea remained visible only for a short time. The lower smaller ganglia were each supplied with a single pair of branches, but the supply to the larger cephalic ganglia seemed to be by two sets of main lateral trachea from above and below, each set giving off branches as shown in the figure. The abdominal ganglia are supplied more simply. In none of the centers was there the branching of the tracheoles to the degree found in Evalljapax.

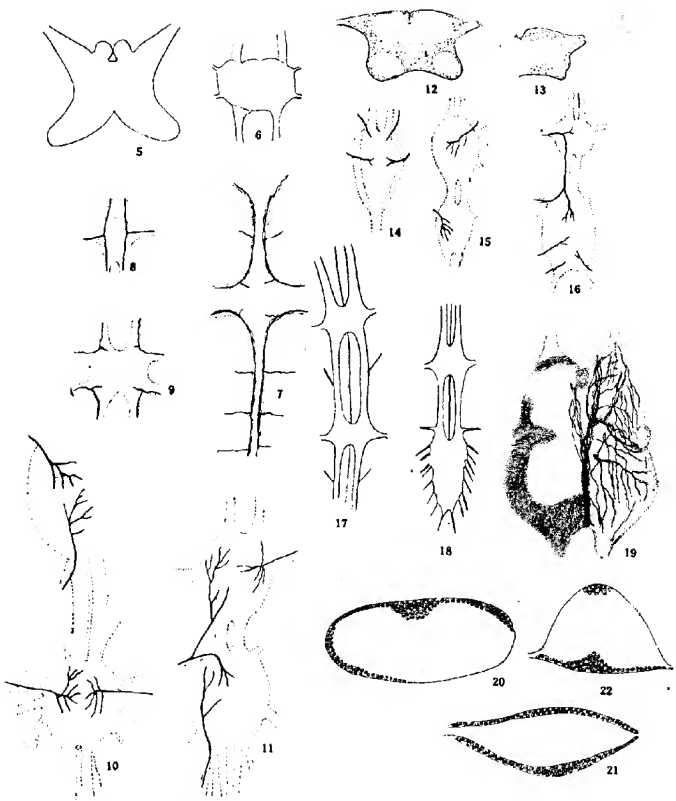

Fig. 5. Brain of Campodea from above. × 75.
Fig. 6. Thoracic ganglion of Campodea from above. × 75.
Fig. 7. Region of last two thoracic ganglia above and some of the abdominal ganglia in the lower part of the figure, from Campodea, showing the lateral tracheal tubes. × 75.
Fig. 8. One of the abdominal ganglia of Campodea showing tracheal tubes. × 75.
Fig. 9. One of the thoracic ganglia of Campodea showing tracheal tubes. × 75.
Fig. 10. Tracheal distribution in the subesophageal and first thoracic ganglion of Evalljapax. × 50.
Fig. 11. Tracheal distribution in the last two ganglia of Evalljapax. × 50.
Fig. 12. Brain of Lepisma showing where the deeper masses of cells are as seen from a methylene-blue preparation. × 20.
Fig. 13. Part of the brain of Lepisma from below showing areas of most abundant cells. × 20.
Fig. 14. Subesophageal ganglion of Lepisma showing distribution of trachea.
Fig. 15. Third thoracic and first abdominal ganglia of Lepisma showing tracheal distribution. × 20.
Fig. 16. Last two abdominal ganglia of Lepisma with tracheal distribution. × 20.
Figs. 17 and 18. Abdominal ganglia of Machilis, showing medial nerve. × 22.
Fig. 19. Brain of Evalljapax from above showing distribution of thickest masses of cells on the left side and the distribution of tracheal vessels on the right side. × 50.
Figs. 20 and 21. Supra- and subesophageal ganglia of evalljapax as shown in longitudinal section. × 50.

GENERAL CHARACTER OF THE BRAIN.

One of the chief differences between the brains of Campodea and Evalljapax as compared with Lepisma and Machilis is due to the lack of eyes in the first two. There are numerous differences between the brains of the first two genera. The shape of the brain of Campodea is given as it appears when viewed from above in Figure 5. Longitudinal and cross sections through the brain show the ventral parts largely without cells. (Figures 23-26).

The cephalic and mid-dorsal regions are not so well supplied as the lateral dorsal and caudal regions; the caudal lateral region of the brain has the largest mass of cells. Many fibers run from the brain, from or to, forward, median or lateral parts down the connectives to the subesophageal ganglion and farther. There are also numerous small bundles which connect all parts. In the latero-caudal region there are central masses of denser fibers. Three well-marked masses at least may be seen on each side near the dorso-lateral region, Fig. 23. These may represent the areas which in other species help form the mushroom bodies. The brain of Evalljapax is shown from above in Fig. 19. On the right side is shown the position of the tracheal tubes of that side and on the other the position of the larger cell areas as shown in the methylene blue preparation. The shape of the ganglion is quite different from that of Campodea, as the drawing indicates. There are cells on the dorsal side of the brain, but they are few compared to the other great areas indicated in the drawing. In section the brain seemed simpler in structure than that of Campodea, but this in part may have been the fault of the preparation. As in Campodea, the ventral regions of the brain are without cells. No clear indication of mushroom bodies was seen, and the connections between different parts of the brain and the connectives and subesophageal ganglion seemed less marked.

Machilis and Lepisma also differ from each other to a marked degree in brain structure and arrangement. The general distribution of cells above and below is shown in two figures, 12 and 13, which were stained in methylen blue. In an adult there seem to be not as many cells in proportion to the general area of fibers as in some of the other genera. The middle line both above and below is largely without cells as shown in Fig. 32,

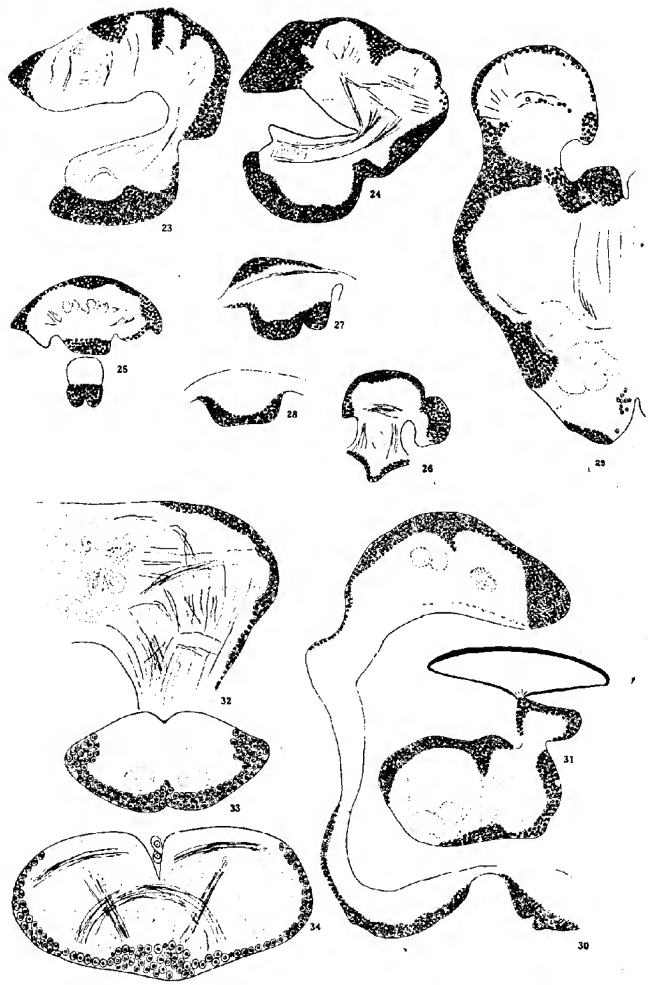

Fig. 22. Cross section through the first thoracic ganglion of Evalljapax. × 50.
Figs. 23 and 24. Longitudinal sections through the brain and ventral ganglion of Campodea. The cephalic end is to the right and the brain is above. × 150.
Figs. 25 and 26. Cross sections through the brain and first ventral ganglion of Campodea taken at different levels. × 150.
Fig. 27. Longitudinal section through the first thoracic ganglion of Campodea, the dorsal side is above, the cephalic end at the left. × 150.
Fig. 28. Longitudinal section through the second thoracic ganglion of Campodea, the dorsal side is up. × 150.
Fig. 29. Longitudinal section through the brain of Machilis. Only one-half is shown. The optic lobe region is at the top of the figure. × 150.
Fig. 30. Longitudinal section through the brain and two ventral ganglia of Machilis. × 150.

which is nearly a cross-section through the brain of an adult. In this a much more complicated structure of fibers and fibrils is presented than in any of the others so far compared. The stalks and roots of the mushroom-bodies are shown in Fig. 32, also the so-called central body. The arrangement of the fibrillar material of the mushroom seems to have a different arrangement and development than in Lepisma saccharina studied by Bottger, 1910. In his descriptions and figures an anterior and posterior division of the cap of the fibrous material or "Traube," is given but in the species studied at this time the "Traube" has a different position and is not clearly made up of more than one main lobe on each side. Each of these main lobes as shown in the figure has five secondary lobes instead of four shown by Bottger. In the region of these masses of fibrous material of the mushroom-bodies there are a number of irregular fibrous bundles which may represent other parts of this structure. On the whole, there is a fairly close resemblance to the brains studied by Bottger and differences may be due to the fact that this is not the species which he studied, but our most common local species whose exact identity has not yet been reported to me by special students of this group.

One of the first differences between the brains of Machilis and Lepisma is shown because of the different position of the eyes. The eyes of Machilis are connected with the caudal end and this dorso-caudal region forces the parts of the brain usually found here, farther forward. This is not an unusual condition among the brains of invertebrate animals, in some amphipod Crustaca as compared with nearly related isopods there is a similar shifting. In general, the posterior lobe region of the brain of segmented animals seems to represent its highest center, but shiftings such as just mentioned may often change the usual arrangements.

The second marked difference between Machilis and Lepisma at least in all specimens studied, both small and large, was in the

Fig. 31. Longitudinal section through the edge of the brain of Machilis, the section is through the eye above and to the right. The cephalic end is towards the left. × 150.

Fig. 32. Cross section through the brain of Lepisma, only the right half is shown. × 150.

Figs. 33 and 34. Cross sections through two levels of the first thoracic ganglion of Lepisma. The dorsal side is up. × 150.

way of a complete lack of anything which might strictly be called mushroom-bodies in Machilis. There are however groups of fibers in the proper region of the brain in specimens of all sizes, but these are hardly more marked than in Campodea. The usual distribution of cells was found in this genus. Some indication of the complex but usual arrangement of fibers in the optic lobe region is shown in the Figures. Association, projection and commissural fibers are easily demonstrated. (Figs. 29-31).

In all the brains examined, cells of the usual and well-known types for insect brains were clearly seen. Especially was this the case with the representatives of Lepisma and Machilis. In these also there were more differences between cells. In all, nerve cells were held in place and otherwise supported by neuroglia cells and neuroglia nets. In all, the fibrils within the central portions of the ganglia formed intricate tangles with the possibility of almost unlimited connections between parts. In the smaller and simpler species few well separated definite tracts were found, fewer than in Lepisma and Machilis. This is in part due to the fact that the cells, fibers and fibrils are not so large, but there may be other reasons.

The ventral ganglia in the different species differ greatly in complexity. They seem to be the simplest in Campodea and the most complex in Lepisma. In all, the more abundant cells as is usual, are ventrally placed and the dorsal cells are usually limited to the sides and to a small group in the mid-dorsal line.

If we consider the brain from its three main pairs of nerves or three main regions on each side to consist of three lateral segments, then we must consider the subesophageal ganglion from its nerves and lobings to consist of at least two segments and very possibly more. The first thoracic ganglion in Machilis and Campodea are evidently composed of two segments as shown in the figures. The cell arrangement and fibrous bands were found to be most complex in Lepisma. A few figures are shown of ventral ganglia of several of the species (Figs. 22, 27, 28, 33 and 34) and a more detailed examination of the first thoracic ganglion of Lepisma, is given below.

Beginning at the cephalic end we find the two masses of the connectives distinct for a short distance, then cells are located ventrally and laterally, being thickest on the mid-ventral line.

The cells are from one to three layers thick. The fibers in the middle line gradually form into a thick mass of commissural strands. There are also a number of diagonal fibers shown in the plane of the cross section. Farther down a second commissure makes its appearance as a narrow area crossed by coarse fibers. This crosses the center of the ganglion. Farther along a marked, much arched commissure occupies a short distance. The second commissure mentioned is quite extensive but not very thick. More dorsal arched fibers show farther along, these cross to some degree and come from lateral ventral cells, in part at least. In about the central part of the ganglion the other commissures and arched fibers have about disappeared and two small central masses of commissural fibers are evident and two ventral bundles of longitudinal fibers and marked crossings from the ventral to the dorsal side are seen. Farther along the two median commissures give place to one median arched commissure, while many branches are seen at various angles. This arched band disappears and another one comes in contributed to by marked masses of lateral cells. A few dorsal cells send their fibers straight into the ganglion from above. Farther down a more dorsal arched commissure comes in. Later there are two ventral straight bands of fibers and then a single median band reaching from side to side, then very soon the ganglion divides into the two ventral connectives. Cells on the ventral and lateral sides are seen at all levels. A few dorsal cells are seen near the central regions of the ganglion.

In the second thoracic ganglion a similar condition was noted, at least nine commissures were counted.

ABDOMINAL GANGLIA.

A general summary of the structure of abdominal ganglia of Lepisma will give an idea of their complexity:

1. Cells chiefly ventral are found in from one to two layers. The lateral ventral groups have three cell layers. There are a few mid-dorsal cells of various sizes.
2. There are in each ganglion a large number of commissures, both straight and arched, ventral and dorsal.
3. Fibers cross dorso-ventrally and caudally.
4. Fibers run short distances to nearby cell groups.

5. Cells of various sizes send fibers into the mass of the ganglion.

6. The longitudinal fibers to the connectives may be found in every part, but they are not always evident because of the many fine fibrils from various regions all woven in with them.

SOME GENERAL CONCLUSIONS.

The nervous systems of the four genera studied show some similarities but many differences. The general position and number of the ganglia is quite similar. Campodea, the least specialized in most respects, has one less ventral ganglion. The general shape of the four brains are quite different, even those without eyes are not alike and those with eyes have them so differently connected with the brain that the whole arrangement of the nervous system at this point is altered. Nerve cells differed chiefly in size and minor arrangements. The largest animals had the largest nerve cells. The general course of fibers and fibrils could be traced but special tracts were not traced very far. The general areas of mushroom bodies were determined for all. Only in Lepisma were these structures well developed, in Machilis and to a less degree in Campodea condensations of fibrils were taken to indicate them.

The general distribution of tracheal vessels is as follows: The brain has three main branches on each side, the subesophageal ganglion two branches from each side, the thoracic and abdominal ganglia as a rule have one branch each on a side and the last abdominal ganglion has usually two branches on each side. The brain of Campodea was not easily removed, so that the condition there was not so clearly made out, but the appearance so far as could be told was as stated for the rest. The thoracic and abdominal ganglia, however, have a distribution which is not like the rest. Possibly the long lateral trachea on either side with its branches to the ganglia may represent a more primitive if not an absolutely different condition. For this and other reasons I am inclined to think of Campodea separated from the other genera by a wide gulf. Japax seems separated from the rest by the next widest gulf.

The segregation of fibrils in clumps means a closer union in some places than others; this probably means: 1. Fibrils are closely massed that go in the same direction. 2. In some

places groups are closely correlated because of this relation to each other.

Nuclei are distinct from the fibers and fibrils; they are nutritive centers. The cell bodies also are important in metabolism, but they are not important enough centers for the mingling of many fibers. The individual fibers from cells are less important in the relationship of parts than the groups and masses of fibers and fibrils from many cells in conveying impulses. Association of fibrils seems more important outside of cells than in them. Why should not lateral as well as terminal contacts be important in conveying impulses? The fibrils are carried out in fibers, but the fibrils break away and are distributed in complex ways. It seems that an impulse may flow through ganglia like floods of water through a swamp. The impulses follow the lines of least resistance, if the bundle is large the direction is more definite, if small, of less importance. The nervous system of invertebrates might be compared to the heart and circulation of insects; it, like the heart, receives and passes on, but the distribution is not definite until there is a more perfect insulation. Insulation may be accomplished in several ways: (1) Bundles of fibers protect the central strands with a similar destination from loss to the surrounding parts; (2) The fibers in some cases remain distinct from each other, or the fibers are large and the inner fibrils are protected; (3) Neuroglia cells and neuroglia nets may help a little; (4) In vertebrates the more perfect insulation by means of myalin seems the most efficient protection.

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NEW MYCETOPHILIDAE FROM CALIFORNIA.

By ESTHER GUTHRIE, Stanford University, California.

During the fall, winter and early spring of 1915-16 a number of species of fungi was collected by the writer, in the environs of Stanford University for the purpose of studying Mycetophilid fauna.

The collection consisted of twenty-one species of fungi. These were determined for me by Prof. McMurphy of the Botany Department.

Some of these fungi furnished no insects while others furnished insects of several species, as shown in the appended table—the same species, in some cases, being found in more than one species of fungus.

The following species are described as new.

I. **Mycetophila maculosa** n. sp.

Male: Length 4 mm. Head yellowish; antennæ brownish; scape yellowish, flagellum gradually darkening from base to tip. Humerus yellow; pleuræ brownish. Two vittæ on dorsum, continuing over scutellum. Metanotum brown with narrow light median line. Hairs pale; setæ dark. Abdomen brown; posterior margin of second and succeeding segments narrowly yellow; Hypopygium (Plate XXV, A) coxæ and legs yellow; middle and hind coxæ with spot on posterior surface. Tips of middle and hind femora and metatarsi narrowly dark brown. No setæ on flexor surface of middle tibiæ; two ranges of setæ on extensor surface of hind tibiæ. Fore metatarsis about 7-8 as long as tibiæ; hind metatarsi about .9 as long as remaining joints taken together. Wing, yellowish gray, hyaline; dark brown spot at cross veins; barely clouded nearly midway between cross veins and apical margin, extending over marginal and first submarginal cells. Branches of cubitus not divergent. (Plate XXV, Fig. 1a). Halteres yellow.

Female: Same as male, with some little variations in color.

Reared from *Pleurotus ostreatus*. California Redwood Park, October, 1915.

Type No. 569-5-1, L. S. J. U., Entomological Museum.

II. **Mycetophila permata** n. sp.

Male: Length 4 mm. Head dark brown. Two ocelli contiguous to eye margin. Antennæ lighter brown, longer than head and thorax; scape, base of flagellum and palpi yellow. Thorax brown; three coalesced broad brown stripes on mesonotum, the two lateral ones

crossing the scutellum. Pleuræ dark brown, setæ brown, hairs yellow; metanotum brown. Hypopygium small, yellow (Plate XXV, B). Coxæ and legs yellow; brown spot on posterior lateral base of middle and hind coxæ. Tips of middle and hind femora brown. Middle tibiæ with three setæ on the flexor surface and two ranges of setæ on the extensor surface. Wing yellowish hyaline, with central brown spot and preapical fascia distinct across M_3 (Plate XXV, Fig. 1b). Halteres very pale.

Female differs in having a wing cloud in anal cell, close to Cu_2.

Reared from *Polyporus sulphureus*. Stanford University, October.

Type No. 569-2-1, L. S. J. U., Entomological Museum.

III. **Mycetophila alata** n. sp.

Male: Length 4 mm. Antennæ brown, palpi brown. Thorax brown; three dark brown, broad vittæ on the mesonotum. Pleuræ brownish; metanotum brown; setæ brown hairs pale. Abdomen dark brown; hypopygium small, yellow (Plate XXVI). Coxæ and legs yellow. Tips of middle and hind femora brown. Middle tibiæ with three setæ on flexor surface, and two ranges of setæ on extensor surface. Wings yellowish hyaline, with central brown spot and preapical fascia arising at tip of R_1 (Plate XXVI, Fig. 2a). Halteres pale.

Female: Differs in having scape and base of flagellum yellow, and wing cloud in anal cell.

Reared from *Polyporus sulphureus*. Stanford University, December.

Type No. 569-6-1, L. S. J. U., Entomological Museum.

IV. **Allodia dentica** n. sp.

Male: Length 5 mm. Lateral ocelli contiguous to eye margin; middle ocellus smaller and in a direct line with the two lateral ones. Vertex brown; face, palpi and scape yellow; flagellum brownish. Antennæ not as long as head and thorax together. Thorax yellowish; mesonotum with three brown stripes, the median one broadening anteriorly and extending forward to anterior margin of mesonotum. Scutellum yellowish with four large setæ near distal margin. Metanotum brown with narrow light median line. The pleuræ yellow; setæ dark brown; hairs pale. Abdomen yellowish; venters yellow, dorsum brownish, with 5th and 6th segments widely brown. Coxæ and legs yellow; tibial spurs brownish. Fore metatarsus shorter than the tibia and longer than the fore coxa. Five setæ above the fore coxa on the humerus; mesosternum without setæ; four setæ on mesosternum above hind coxæ. Second tarsal joint with a peculiar cupped and comb-like arrangement, with four sharp spines laterad and basal to the comb (Plate XXVII, Figs. 5, 5a). Wings yellowish hyaline; subcosta ends in R_1; cubitus forks slightly proximad of proximal end of cross-vein (Plate XXVII, Fig. 3a). Hypopygium as shown on Plate XXVII, lower forceps terminating in broad chitinized process which terminates in a row of blunt teeth (Plate XXVII, Fig. 3). Halteres yellow.

Reared from *Pleurotus ostreatus, Polyporus sulphureus*, October and December, 1915, California Redwood Park.

Type No. 569-1, L. S. J. U., Entomological Museum.

Va. *Genus **Johannseni** n. genus.

Front narrow; 2 lateral ocelli contiguous to eye margin; 1st and 2nd palpal joints slightly swollen, 1st little longer than 2nd, 3rd nearly equalling 1st and 2nd in length. Antennæ as long as thorax, slightly tapering toward tip. Abdomen compressed. Hypopygium of male small (Plate XXVI, Fig. 3, 4, 5, 6,). Legs short, femora moderately broad, flattened; tibia strong, enlarged at ends, with long spurs and strong setæ. Posterior basal setæ of hind coxæ present. Subcosta short, ending in R_1; costa not produced beyond the Rs. Fork of media under base of Rs. Cubitus forks distad of fork of M. Anal vein long and stout, reaching below fork of Cu. (Plate XXVI, Fig. 2b).

Differs from *Brachypeza* in wing venation, and antennal structure; from *Allodia* in structure of tibia, wing markings and size of tibial setae; from both in having but two ocelli, and in the presence of the strong first anal vein.

Reared from *Polyporus sulphureus*. October.

Type specimens deposited in museum collection at Stanford University.

Vb. **Johannseni aurei** n. sp.

Male: 5 mm. long. Robust. Antennæ as long as thorax; scape yellow; flagellum brownish. Palpi, proboscis and face yellow; vertex with darker transverse fascia. Hairs yellow; on each side a row of brown setæ extending ventrad from ocellus over the gena. Thorax yellow; scutellum with two basal brown spots, 4 marginal setæ. Row of yellow hairs on anterior margin of mesonotum. Pleuræ yellow. Abdomen reddish-yellow; hypopygium small (Plate XXVI). Coxæ and legs yellow, stout, tibia broadened at end. Femora reddish-brown at tips; tarsi brownish. Wings grayish hyaline with central black spot. Large preapical fascia, and cloudy about the margin. (Plate XXVI, Fig. 2b). Halteres yellow.

Female same.

Reared from *Polyporus sulphureus*. October. California Redwood Park.

Type No. 569-7-1, L. S. J. U., Entomological Museum.

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*I take pleasure in naming this genus for Professor Johannsen of Cornell University, who kindly compared my new species with types of nearly related species.

The following table shows the fungus host for each species of Mycetophilid collected.

FUNGUS	COMMON NAME	DATE	LOCALITY	MYCETOPHILIDAE REARED
Pleurotus ostreatus	Oyster mushroom	Oct., 1915	Calif. Redwood Park	Mycetophila maculosa n. sp. Johannseni aurei n. s. Mycetophila alata n. s. Mycetophila mutica Loew Allodia dentica n. s.
Polyporus sulphureus	Sulphur-colored mushroom	Oct., 1915	Calif. Redwood Park	Mycetophila permata n. s. Mycetophila alata n. s. Mycetophila mutica Loew Allodia dentica n. s.
Armellaria mellea	Honey mushroom	Oct., 1915	Stanford Univ. vicinity	Mycetophila punctata Meigen
Pleurotus Subsapidus	Sapid mushroom	Dec., 1915	Stanford Univ. vicinity	Mycetophila maculosa n. s. Mycetophila punctata Meigen
Hypholoma fasaculare		Jan., 1916	Stanford Univ. vicinity	No insects
Hypholoma appendiculata	Appendiculate mushroom	Jan., 1916	Stanford Univ. vicinity	Dipteron
Hydrocybe?		Jan., 1916	Stanford Univ. vicinity	Mycetophila punctata Meigen Exechia sp.
Boletus granulatus	Granulated mushroom	Jan. & Feb., 1916	Stanford Univ. vicinity	Mycetophila punctata Meigen
Amanita muscaria	Fly mushroom	Jan., 1916	Milbrae	Mycetophila punctata Meigen
Russula?		Jan., 1916	Stanford Univ.	Mycetophila punctata Meigen
Tricholoma personatum	Masked mushroom	Jan., 1916	Stanford Univ.	Boletophila hybrida Meigen
Cortinarius?		Jan., 1916	Stanford Univ.	Boletophila hybrida Meigen
Agaricus?		Jan., 1916	Stanford Univ.	Dipteron
Clitocybe?		Jan. & Feb., 1916		Exechia sp. Meigen Mycetophila punctata Meigen

FUNGUS	COMMON NAME	DATE	LOCALITY	MYCETOPHILIDAE REARED
Locellina stercoraria		Feb., 1916	Stanford Univ.	Exechia sp. Meigen Mycetophila punctata Meigen
Lactaria insulsa	Pepper mushroom	Feb., 1916	Stanford Univ.	Mycetophila mutica Loew
Paxillus?		Feb., 1916	Stanford Univ.	Mycetophila punctata Meigen
Coprinus comatus	Shaggy maid	Mar., 1916	Stanford Univ.	Mycetophila punctata Meigen
Coprinus atramentarius	The Inky mushroom	Mar., 1916	Stanford Univ.	No insects
Stropharia semigloboides		Mar., 1916	Stanford Univ.	Mycetophila punctata Meigen
Helvella?		Mar., 1916	Stanford Univ.	No insects

The most abundant and most common Mycetophilid species found during the season was Mycetophila punctata Meigen. The eggs of this species were collected from between the gills of a Hydrocybe. (?) They were small, white, oval bodies, lying singly between the gills. Several of these were individually isolated in small vials with a portion of food. These eggs hatched in from twenty-four to forty-eight hours.

The larvae fed in the fleshy portion of the fungus, and passing quickly through five instars, pupated within six or eight days. Pupation took place within a silken cocoon, usually in the ground, and the adult insect issued within three days.

EXPLANATION OF PLATES.

PLATE XXV.

1a, Wing of *Mycetophila maculosa* n. sp.; A, Hypopygium of *Mycetophila maculosa* n. sp., (lateral aspect); 1, dorsal aspect of hypopygium; 2, upper forceps (one side), of hypopygium; 3, lower forceps (one side), of hypopygium; 4, ventral sclerite of hypopygium.

1b, Wing of *Mycetophila permata* n. sp.; B, Hypopygium of *Mycetophila permata* n. sp. (lateral aspect); 5, lower forceps; 6, upper forceps; 7, dorsal sclerite; 8, ventral sclerite.

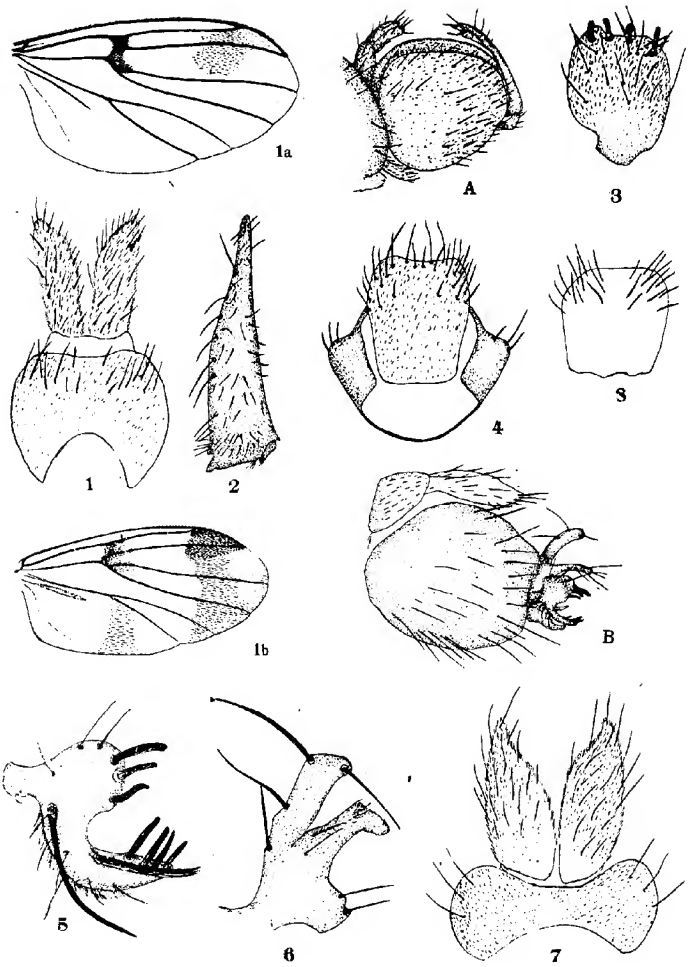
PLATE XXVI.

2a, Wing of *Mycetophila alata* n. sp. A, Hypopygium of *Mycetophila alata* n. sp. (lateral aspect); 1, dorsal sclerite; 2, upper forceps; 3, lower forceps.

2b, Wing of *Johannseni aurei* n. sp. (lateral aspect); B, hypopygium of *J aurei* 4, dorsal sclerite; 5, upper forceps; 6, lower forceps.

PLATE XXVII.

3a, Wing of *Allodia dentica* n. sp. A, Hypopygium of *Allodia dentica* n. sp. (lateral aspect); 1, dorsal sclerite; 2, upper forceps; 3, lower forceps; 4, ventral sclerite; 5, fore-tarsus (except first tarsal segment); 5a, second tarsal segment.



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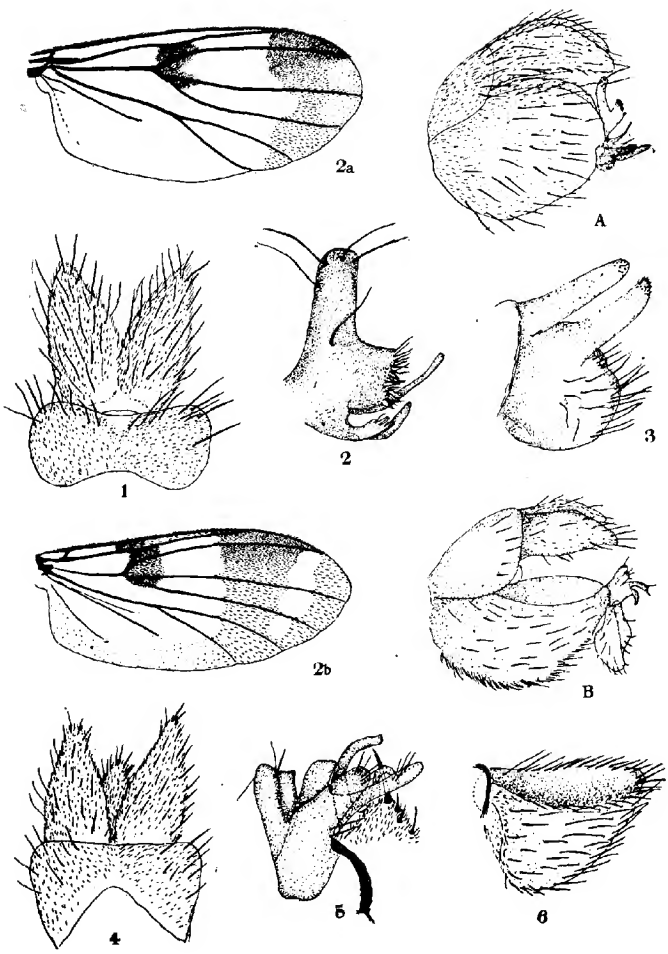

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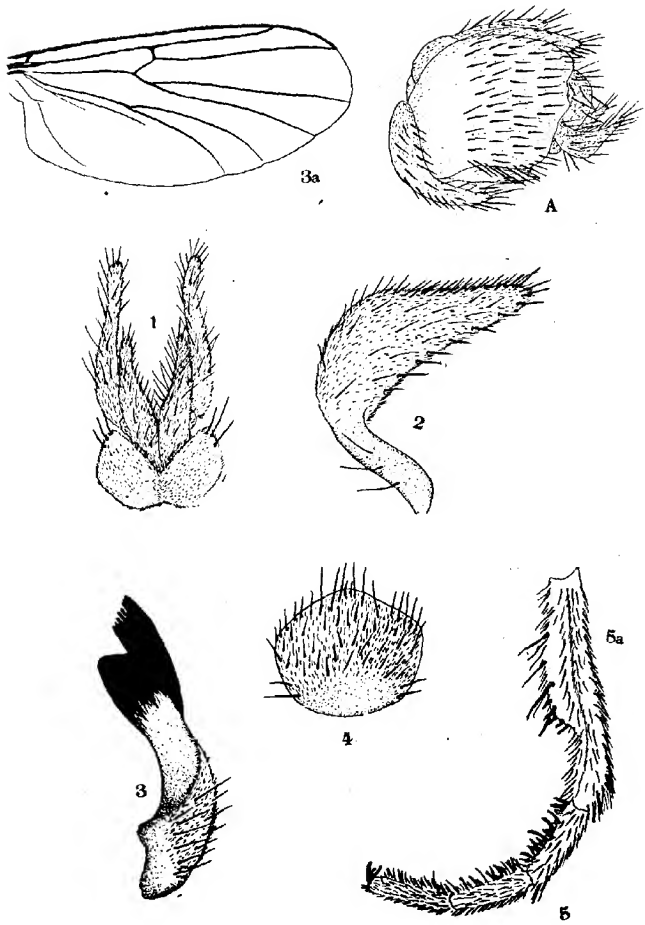

Esther Guthrie

INSECTS IN BURMESE AMBER.

By T. D. A. Cockerell.

The amber from Burma continues to yield interesting insects, those now reported including the largest and finest yet discovered. Mr. Swinhoe has presented the collection to the British Museum, but for obvious reasons it is retained for the present in this country.

Coleoptera.

Acmæodera burmitina sp. nov. (Buprestidæ).

Length 19 mm., width of thorax posteriorly 6 mm.; length of elytra 15 mm., width of an elytron in middle (viewed from above) 3 mm.; original color uncertain, but apparently not metallic; thorax broader than long, the posterior angles sharp, the lateral margins nearly straight, nodulose, the dorsal surface strongly punctured, the punctures about as far apart as the width of one, no striæ on posterior margin; scutellum not evident; elytra punctured basally, but the sculpture, well developed in middle, consisting essentially of about nine rows of large elongate punctures, with rows of small dot-like punctures alternating with them; margin of elytra finely nodulose, toward apex definitely denticulate; claws simple. The structure of legs, antennæ and palpi, so far as visible, is shown in the figures.

Burmese amber; from Mr. R. C. J. Swinhoe. This is the beetle referred to in Ann. Ent. Soc. Amer., X, (1917) p. 14, as an Elaterid nearly 20 mm. long. Closer examination shows it to be a Buprestid, agreeing with *Acmaeodera* in the sculpture of thorax and elytra, the dentate margin of elytra posteriorly, and the lack of an evident scutellum. The sharp salient posterior angles of thorax are peculiar, and give it an Elateriform appearance. The insect is not evidently hairy. The one antenna visible is incomplete, but what there is agrees fairly well with *Acmaeodera*. Mr. J. A. Hyslop, to whom I sent a rough sketch, suggests that the insect may fall in the common oriental genus *Chrysodema*. I have no *Chrysodema* for comparison, and leave the species in *Acmaeodera*, since it appears to agree sufficiently with that cosmopolitan genus. Two species of *Acmaeodera* occur in the Miocene of Florissant, and two others in the Miocene of Baden, but none in Baltic amber. *A. burmitina* is in the same slab of amber as the types of *Dermestes larvalis* and *Apenesia electriphila*. The same slab also contains two species of Elateridæ.

Eurygenius wickhami sp. nov. (Pedilidæ).

Length about 5.5 mm., entirely rufotestaceous; eyes extremely large, apparently not emarginate; mandibles very large, prominent, the outer margin very convex; maxillary palpi large, the last joint elongate, subtriangular; antennæ 11-jointed, first joint thickened apically, second much shorter than third, fourth longer than third, eleventh longer than tenth, but not so long as ninth and tenth together; thorax subcircular, glabrous, the margin finely ciliate, the sculpture

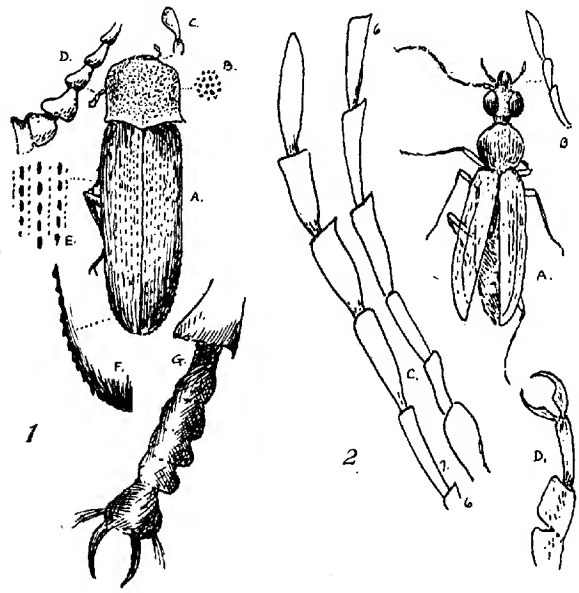

Fig. 1. Acmaeodera burmitina. G—middle leg.
Fig. 2. Eurygenius wickhami. B—Maxillary palpus; C—Antenna; D—End of anterior leg.

consisting of irregular longitudinal grooves; elytra reaching to end of abdomen, and grooved much as thorax, humeri prominent; legs slender, tibial spurs short, tibiæ with much short hair on apical part; claws simple, but expanded basally, with a distinct inner angle. The following measurements are in microns: length of last joint of maxillary palpus, 270; antennal joints, length, (2) 160, (3) 240, (4) 304, (9) 256, (10) 240, (11) 320; length of anterior tibia, 930; middle tibia, 1200; hind tibia, 1600.

Burmese amber; from Mr. R. C. J. Swinhoe. In the same slab as the type of *Acmaeodera burmitina*, and about 8 mm. from it. It is named after Professor Wickham, who has done so much to elucidate the fossil Coleoptera, and gave me valuable advice concerning this specimen. I at first took this insect for a new genus of Oedemeridæ, not noticing the short but evident neck.* It may go in *Eurygenius* as interpreted in the broader sense, though it may hereafter be treated as the type of a distinct genus. It quite closely resembles *E. fragilicornis* Champion from the Seychelles, differing however by the prominent mandibles, relatively slender last joint of palpus, more globose thorax and sculpture of elytra. When Casey discussed the Eurygeniinæ (Eurygeniini, Casey) in 1895, he remarked that they were wholly confined to the new world. Since that time the genus has been found scattered over the eastern hemisphere, *E. niponicus* Lewis coming from Japan, *E. africanus* Kolbe and *E. nigricolor* Pic from the African continent, *E. hovanus* and *E. griseopubens* of Fairmaire, from Madagascar, *E. abdominalis* Pic from Bengal, and *E. fragilicornis* and *E. convexicollis* of Champion from the Seychelles. Reitter recognized a *Pedilus* in Baltic amber.

Elater (sens. latiss.) **burmitinus** sp. n. (Elateridæ).

Length about 11 mm., elytra 7.7 mm.; narrow, width at base of elytra about 3 mm.; thorax finely punctured, the posterior corners sharp, obliquely truncate (see Figure); elytra finely hairy, obtuse at apex, surface with eight simple parallel striæ, between which are numerous very minute piliferous punctures. The color is uniform black.

Burmese amber, from Mr. R. C. J. Swinhoe. Certainly not a species of the true genus *Elater*, but I am unable to refer it to a modern genus with any assurance, the under side and appendages being invisible. It is in a slab, 8 mm. from the type of *Hodotermes tristis*.

*Say described a member of this group as *Oedemera vestita*.

DIPTERA.

Burmacrocera new genus (Mycetophilidæ).

Closely allied to Macrocera, with which the venation nearly agrees, but there is no cross-vein between subcosta and radius, Cu_2 is not bent, the subcosta is longer, and the anal fails before the margin. Second antennal joint cylindrical, not globose; antennæ 16-jointed, very slender, but not nearly so long as the wings. Legs very long and slender, so far as the fragments preserved indicate; tibial spurs very small, claws minute. Thorax with coarse bristles; abdomen slender, petiolate basally; eyes (male) extremely large, covering most of head, the facets elevated, low-conical. Type the following.

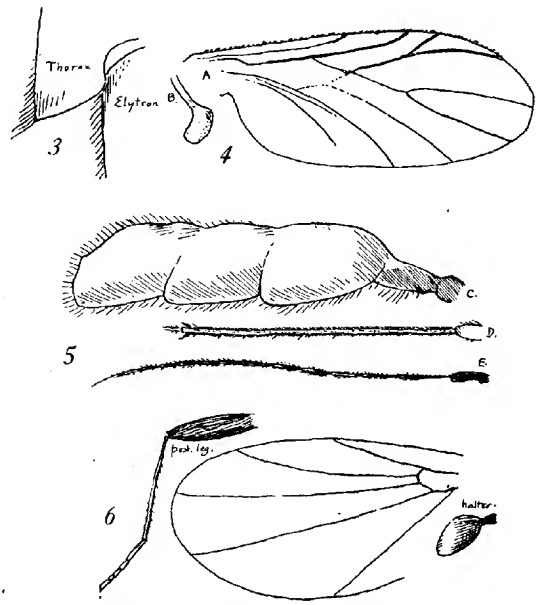

Fig. 3. Elater burmitinus. Posterior angle of thorax.
Fig. 4. Burmacrocera petiolata. Wing. B—Halter.
Fig. 5. Burmacrocera petiolata. C—Abdomen. D—Tibia. E—Antenna.
Fig. 6. Burmitempis halteralis.

Burmacrocera petiolata sp. n.

Male: Black, the wings clear, without spots, veins testaceous; thorax with long hair; abdomen of uncertain length, the apical part lacking in the type; a hind leg (presumably) occurs as a separated fragment, with the apex of the femur, and all the tibia and tarsus; the

tibia and tarsus have short hairs, and short spines at intervals. The following measurements are in microns: Length of wing about 2000; length of cell in fork of media, 800; length of radial sector beyond origin of upper branch, 624; length of antenna, 1200; third antennal joint, 160, sixteenth 80; length of abdomen as far as preserved (see Figure), 1120; hind tibia, 1120; joints of hind tarsus, (1) 608, (2) 224, (3) 160, (4) 88, (5) 96. The thorax is shriveled and distorted in the type.

Burmese amber, from R. C. J. Swinhoe. In outer slab cut from same lump as slab containing the type of *Acmaeodera burmitina* etc., about 10 mm. from the angular corner.

This remarkable fly is evidently allied to *Macrocera*, a genus which occurs in the modern fauna, and also in diverse forms in Baltic amber. The venation is very similar to that of *Palaeoplatyura*, which Johannsen regards as the most primitive in the Mycetophilidæ, but there is absolutely no radio-medial cross vein, and the strongly setose thorax also disagrees with that genus.

TRICHOPTERA.

Plecophlebus new genus. (Odontoceridæ?)

Small species with anterior wings moderately broad, obtuse apically, not densely hairy. Subcosta rather short, not connected with radius; radius deflected downward toward the end, thence curving and eventually meeting the sector at right angles, but before that emitting three branches to costa; sector enclosing a long discoidal cell; upper branch of sector emitting at end two branches directed obliquely upward to apicocostal margin, and also with a cross-vein to second branch, thus enclosing an elongate cell, the base of which rests on the discoidal; third branch of sector (R_5) simple, arising from lower apical corner of discoidal cell; no chitinous dark dot in third apical cell; anterior branch of media not forked; median cell present, elongated; M_3 and M_4 separating beyond end of median cell; structure of cubital and anal veins not ascertainable.

Plecophlebus nebulosus sp. n.

Anterior wing about 6 mm. long, hyaline, with suffused brown spots as shown in Figure.

Burmese amber, from R. C. J. Swinhoe. I had determined this as a new genus, and on submitting a sketch to Dr. N. Banks, he kindly informed me that no genus with such characters was known to him. Dr. Banks pointed out certain resemblances in the upper part of the wing to the Odontoceridæ, and it is to be remarked that the Odontocerid genera *Electrocerum* and *Marilia*, which occur in Baltic amber, have the

radius ending in the sectòr. In the case of *Plecophlebus* it is not certain that the apparent end of the radius is not a cross vein, the last branch to costa being the true end of the vein. Unfortunately the head of *Plecophlebus* is lost, and the fragments of legs and other parts appear to present no salient characters. Provisionally the genus is referred to the Odontoceridæ, but Dr. Banks notes also a certain resemblance to the Oestropsychids. The character of the venation of the costoapical field will in any case distinguish it from previously known forms.

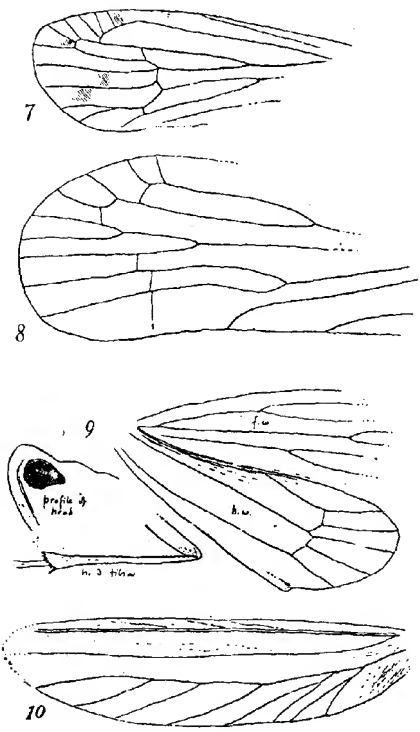

Fig. 7. Plecophlebus nebulosus. Anterior wing.
Fig. 8. Liburnia burmitina. Elytron.
Fig. 9. Liburnia burmitina.
Fig. 10. Hodotermes tristis.

ISOPTERA.

Hodotermes tristis sp. n.

Wing about 4.3 mm. long, dusky grey, the veins distinct. Radius thick (appearing as two fine parallel lines), very close to costa, giving off an uncertain number of delicate branches above; media apparently simple (apex of wing not visible), about midway between radius and cubitus; cubitus with five oblique branches below, the first two soon bifurcating. There is apparently no subcosta.

Burmese amber, from R. C. J. Swinhoe; in a slab cut from the same lump as that containing the type of *Acmaeodera burmitina*, and with the apex of the wing reaching the edge of the slab, where it is 4 mm. thick, about 3 mm. from a broken ferrugious blattid tegmen and 8 mm. from an elaterid beetle. I at first thought this might be a *Termes*, as the superior branches of the radius are delicate and indistinct, but they are certainly present. The remoteness of the media from the radius readily distinguishes it from *Calotermes*. The group Termitinæ doubtless arose through the approximation of the radius to the costa and consequent loss of branches; so the present insect may be considered to represent a development in that direction.

HOMOPTERA.

Liburnia (s. lat.) **burmitina** sp. n.

Length of body about 4.2 mm., to tip of closed elytra probably about 5.7 mm.; dark brown; elytra pale testaceous, without markings; vertex obtuse; frons with very distinct lateral carinæ; tibial spurs very short, about equal (on hind tibia) to width of tibia at apex; apical margin of tibia finely dentate; tarsal joints with apical margins provided with numerous minute straight blunt spines; eyes pyriform, scarcely emarginate below. Venation as shown in Figures. Scutellum not visible.

Burmese amber, from R. C. J. Swinhoe; in a slab cut from the same lump as that containing the type of *Acmaeodera burmitina*, 13 mm. from the margin. The slab is the one having one side rough. Very close to the *Liburnia* is a specimen of *Burmitempis halteralis* Ckll., from which I have made a new figure.

This insect is evidently not a *Liburnia* in the restricted sense. It appears to fall in the vicinity of *Copicerus*, but it has the more primitive, separate anal veins. It should possibly be regarded as the type of an extinct genus, but if so, the separation should be made by one more familiar with Delphacine genera.

PARTHENOGENESIS IN THE PEAR-SLUG SAW-FLY.

By H. E. Ewing, Iowa State College, Ames, Iowa.

Introductory.

But few of our economic insects have been studied more than the common pear-slug or cherry-slug saw-fly, *Caliroa cerasi* Linn., yet concerning some points in its biology and life history we are as yet in doubt. Parthenogenesis, known to occur in some of the saw flies, has been suspected in the case of this species, but does not appear to have been sufficiently proved. Mr. R. L. Webster, in his bulletin on this pest* presents a good account of its biology and life history, but in regard to parthenogenesis (complete and successful) he states that it had not been sufficiently proved, yet some important observations were made which are mentioned in this paper.

Rarity of the Males.

Males of the pear-slug saw-fly have been described, and were at one time supposed to be fairly common. Mr. Webster, however, noticed early in his work with the species the apparent absence of the males around Ames, Iowa. On page 181 of his bulletin he states: "We have collected and examined large numbers of saw-flies, but have never found a male." He also wrote to Mr. S. A. Rohwer, of the U. S. National Museum in regard to the rarity of the males. Mr. Rohwer examined the collection of the museum, and reported that there were no males there, either from Europe or from America. While working at the Iowa Station in 1911, and while at the Oregon Station, 1911-14, I had occasion to examine hundreds of these saw-flies but never found a male. It appears then that if males exist in this country, they must be very rare in certain localities.

Caliroa cerasi differs from many of the saw-flies in respect to the numerical ratios of the sexes, for in some of the species the males are present in abundance, and mate normally with the females. This was shown to be the case with the cherry

*Webster, R. L. The Pear-slug. Bul. No. 130, Iowa Agric. Exp. Sta. (1912).

and hawthorn saw-fly leaf-miner, *Profenusa collaris* MacGillivray, by Parrott and Fulton.† In this regard they give the following: "Out of doors the females appeared in larger numbers at a somewhat earlier period than the males, but judging from collections taken at irregular intervals it does not appear that marked numerical differences existed between the sexes. To all appearances the adults copulated freely. In one breeding cage, containing no males, two females made their appearance, and these were isolated and supplied with cherry twigs to induce oviposition. This they did, and five days later three eggs hatched. This experience suggests that fertilization is not absolutely necessary for the development of the eggs and also indicates that parthenogenesis may occur, although it is perhaps not an important factor in the life of the species."

Experiments at the Iowa Station.

Webster in his bulletin states that parthenogenesis probably occurs in the pear-slug saw-fly, but that it had not been satisfactorily proved. However, he showed that virgin females would deposit eggs and that these eggs would hatch; yet none of the larvæ hatching from parthenogenetic eggs was reared to maturity. In regard to these experiments, Webster states: "Both Mr. Ness and Mr. McCall confined virgin female sawflies in insectary cages and obtained eggs from them. Some of these eggs hatched, but the larvæ were weak and in no case did they live more than a few days. None reached the second stage." These experiments seemed to show that there was not a complete normal parthenogenesis like that which exists in the plant lice, or in fact in the case of some of the other species of saw-flies, but a type similar to that known to exist in the silk worm, where only a few unfertilized eggs hatch, and the issuing larvæ never reach maturity.

Breeding Experiments Carried on by the Writer.

During the month of May, 1913, while rearing the black cherry aphis, *Myzus cerasi* Fab., as food for Coccinellidæ, the life histories of which I was studying, three females of *Caliroa cerasi* emerged in the aphid breeding cages. These breeding

†Parrott, P. J., and Fulton, B. B. The Cherry and Hawthorn Sawfly Leaf-Miner, Bul. No. 411, New York Agric. Exp. Sta. (1915).

cages were quite large, being about three feet high and over three feet in diameter, and each was placed over a young cherry tree that had been cut back so as to be enclosed by the cage. They were out-of-door cages without bottoms, so that any insects emerging from the soil would be caught. On June 6th I observed that two females had emerged in one of the cages which I designated as cage A, and in another, one female saw-fly had emerged. This second cage was designated as cage B. These virgin females began to oviposit almost at once, and by June 15, in cage A, I noted several eggs and six young larvæ, and in cage B another female had emerged, and a few eggs were observed but no young slugs. By July 5, the females had died in cage A, many growing slugs were present but no pupæ. These larvæ continued to grow, and feed in a normal manner, and then to pupate.

On July 31 I noticed the first adult of the second generation (F_1) had emerged. It was very active, and was moving about the upper side of the cage. From now on adults from the parthenogenetic eggs of the first generation females continued to emerge rapidly.

In all, 34 adult individuals were obtained from the parthenogenetic eggs of the two females in cage A. All of them were females, and all were healthy, active and vigorous.

As fast as these females emerged they were isolated and each placed in a gauze-bag breeding cage, which was placed around the end of a cherry branch. These gauze bags were of sufficient size to allow the females considerable freedom, and were placed over the branches several weeks earlier after every leaf had been carefully examined for foreign eggs. This was a precaution against contamination, the bags excluding all the other saw-flies in the orchard.

Some of the data obtained for the rearing of these parthenogenetic individuals are here presented in tabular form.

TABLE I.*

Individual	July 31	Aug. 1	Aug. 3	Aug. 5	Aug. 7	Aug. 8	Aug. 9	Aug. 10	Aug. 12	Aug. 18	Aug. 21	Aug. 22	Aug. 23
1	em.	br. bag					eggs l. dead						
2		em. br. bag							eggs l. dead				
3			em. br. bag						eggs l. dead				
4			em. br. bag						eggs l. alive				
5				em. br. bag					eggs l. alive				
6				em. br. bag					eggs l. dead				
7				em. br. bag						eggs l. dead			
8				em br. bag						eggs l. dead			
9					em. br. bag					eggs l. dead			
10					em. br. bag					eggs l. dead			
11					em. br. bag						eggs l. dead		
12					em. br. bag						eggs l. dead		
13					em. br. bag						eggs l. dead		
14					em. br. bag						eggs l. dead		
15						em. br. bag					eggs l. dead		
16						em. br. bag					eggs l. dead		
17						em. br. bag					eggs l. dead		
18						em. br. bag					eggs l. ad. lost		
19						em. br. bag					eggs l. dead		
20						em. br. bag						eggs. l. dead	
21							em. br. bag					eggs l. dead	
22							em. br. bag					eggs l. ad. lost	
23							em. br. bag					eggs l. dead	
24							em.	br. bag					eggs l. dead
25							em.	br. bag					eggs l. dead
26								em. br. bag					eggs l. dead
27									em. br. bag				eggs l. dead
28									em. br. bag				eggs l. dead
29									em. br. bag				eggs l. ad. lost
30									em. br. bag				eggs l. dead
31									em. br. bag				eggs l. dead
32									em. br. bag				eggs l. dead

*The abbreviations used in this table are explained as follows: em.—adult emerged; br. bag—placed in breeding bag; eggs l.—eggs laid; ad. lost—adult lost.

From this table we observe that all of the 32 virgin females that were reared from the eggs of the 2 first-generation virgin females laid eggs. Since the breeding cages used up to this time were out-of-door cages these observations give us some insight into the seasonal history of the species. The first adult of the second generation to emerge came out on July 31, the last on August 12. Eggs of the second generation adults were first observed August 9. The first record of a death of the second generation adult was August 9. By August 23 all of the adults of the second generation were dead. The period of longevity appears to be quite short for these second generation adults.

The progeny of four of these second generation adults was saved, and reared in four separate breeding cages. Some of the data for these four experiments are given in tabular form in the following table.

TABLE II.

Offspring of Female	Larvae Isolated	When Isolated	Notes for Oct. 5	Notes for Feb. 16	Notes for June 28
No. 2	30	Sept. 11	In soil		
No. 8	30	Sept. 15	In soil	3 pupae found 2 alive	1 dead adult on top of soil. 3 dead larvae in earthern cells 3 dead pupae in earthen cells. 7 dead adults in earthen cells.
No. 14	33	Sept. 17	In soil		Empty earthen cell observed.
No. 25	16	Sept. 27	In soil		3 dead larvae in earthen cells. 3 dead pupae in earthen cells. 3 dead adults in earthen cells.

The results from these four breeding cages were surprising. Of the large number of larvæ obtained (109) during the fall only a single adult emerged the following spring. Examinations during the winter showed that most of the larvæ had pupated and were alive. Later on I made a very thorough search in the soil for predaceous enemies, but found none that I suspected of preying on the larvæ or pupæ. In fact the final examination on June 28 showed that the earthen cells were intact. Of the 23 earthen cells found on this day, 10 contained the mature dead saw-flies. They had passed through their transformations in good shape, but for some reason did not emerge from their earthen cells.

Can it be that parthenogenesis when continued into the second generation descendants causes a great diminution in the vitality of the race?

Observations in the orchard where the first virgin females were obtained showed that the conditions there were similar to those of my experiments. During the first year there were large numbers of the first generation females present, but I did not observe a single male, hence infer that practically all of the eggs laid were unfertilized. These females laid an enormous number of eggs, and apparently almost all of them hatched, for seldom have I seen cherry trees more heavily infested than were these trees during the summer of 1913. The injury was so great that several of the younger trees were killed outright—something unusual in the case of saw-fly infestation. Yet in this same orchard the following spring, scarcely a saw-fly emerged. On June 7, I examined the orchard thoroughly, and did not find an adult or a single egg. It was June 20 before I found eggs, and then only a few of them. The slugs that developed in this orchard in 1913 were very few, and were of no importance from an economic standpoint, in fact most of the trees were absolutely free from them.

Could it be that climatic conditions killed the saw-flies in this orchard and in my cages? During the spring of 1913 we had a very warm spell in March, and later a cold snap. Could this warm spell have so hurried the development of the saw-flies that they were later killed by the cold? I think not, for in other places in the same vicinity the saw-flies came out in abundance. One orchard, only a few miles away, was badly infested and injured the same spring. Could the saw-flies have been killed by a fungous disease? None whatever was detected. Even the bodies of dead individuals were usually free from fungi. Could it be that the ground was so hard during the emerging period that the adults could not make their way out? I hardly think so. At first I suspected this as being the reason, but after keeping the ground soft in two of my breeding cages for many days, I did not get a single saw-fly to emerge. Besides the thorough examination of the earthen cells showed that the adults did not even get out of them.

It appears then that we must look elsewhere in order to find the causes for the non-emergence of these second generation parthenogenetic adults. Judging from the facts collected during my investigations of this species, I am inclined to the opinion that parthenogenesis while normal and completely advantageous for the species in the spring parthenogenetic

generation, when continued into the second generation causes a great diminution in the vigor of the individuals. Some of these second generation individuals die in the larval stage; some, as shown in my experiments, in the pupal stage; and many of them in the adult stage inside of the earthen pupal cases.

Summary.

1. The males of our common pear- or cherry-slug saw-fly must be very rare in certain parts of our country. The examination of several hundreds of individuals obtained at various times during the late spring and summer for three seasons at Ames, Iowa, and for two seasons at Corvallis, Oregon, failed to reveal a single male.

2. The species is parthenogenetic, and successfully so for the offspring of the spring brood of females.

3. The eggs deposited by spring-brood virgin females hatch, and produce normal vigorous larvæ. These feed normally, later pupate and finally produce adults.

4. Unfertilized eggs produce females only.

5. Parthenogenesis when continued for the offspring of the second or summer brood of adults, gave larvæ, a considerable percentage of which failed to pupate, a considerable percentage successfully pupated, but did not transform into the adult stage, and a very large percentage transformed into adult stage, but did not emerge from the enclosing earthen cells.

6. Only a single adult was reared from 109 of the second generation parthenogenetic larvæ.

7. An orchard which was heavily infested with spring-brood females, and in which no males were observed, produced an enormous number of second generation females, which produced in turn an increasing number of second brood larvæ, causing injury so serious as to kill outright several cherry trees of the orchard and to seriously injure all of the trees. From this enormous second brood of larvæ only a very few adults emerged the following spring.

8. I am unable to account for the failure of these second brood larvæ to produce active adults unless it be on account of a lack of vigor due to the absence of fertilization for this brood, yet it is possible that this failure was due to other causes.

A PHYLOGENETIC STUDY OF THE LARVAL AND ADULT HEAD IN NEUROPTERA, MECOPTERA, DIPTERA, AND TRICHOPTERA.*

By G. C. Crampton, Ph. D.

Since practically all of the recent attempts to trace the phylogeny of insects have been based upon the study of the wing veins, which are extremely variable features within the same order, or even family, of insects, it has seemed advisable to examine other less variable structures, and those from widely different parts of the body, in order to ascertain if such a study would confirm or disprove the conclusions reached from a study of the wing veins alone. The present paper is therefore offered as one of a series in which the various structures which appear to be the most useful for a phylogenetic study, have been compared in the Neuroptera, Mecoptera, Diptera and Trichoptera. Many of the accompanying rough sketches were made from material kindly loaned to me by Dr. N. K. Banks, to whom I am deeply indebted for many valuable suggestions, and for the privilege of examining the specimens in his unusually extensive collection of Neuroptera, Mecoptera, and Trichoptera. I am also greatly indebted to Dr. C. W. Johnson for the identification of the Diptera used in the preparation of this paper.

It is customary to speak of this or that single type as the ancestral one for a large group of insects, but I think that this is a mistaken conception, since a study of the ancestral groups (or rather, those which have departed but little from the condition characteristic of the ancestors of other insects) would indicate that the ancestral forms frequently differed quite markedly among themselves, exhibiting *several* developmental tendencies (instead of merely one type) which frequently manifest themselves in the evolutionary series of the forms derived from them. As an illustration of this view, I would call attention to the "short-headed" series of Neuroptera, Mecoptera, and Diptera shown in Figures 1, 2 and 3, and the "long-headed" series of the same groups of insects shown in Figures 4, 5 and 6. These

*Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.

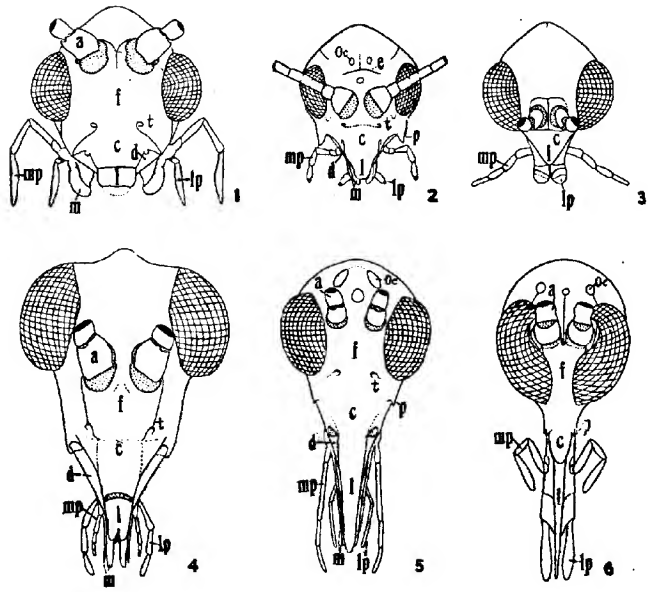

Fig. 1. Head of the Neuropteron *Hemerobius*.
Fig. 2. Head of the Mecopteron *Panorpodes*.
Fig. 3. Head of the Dipteron *Erioptera armata*, O. S.
Fig. 4. Head of the Neuropteron *Nemoptera*.
Fig. 5. Head of the Mecopteron *Bittacus*.
Fig. 6. Head of the Dipteron *Asyndulum montanum* Roeder.

In all cases, excepting figures 12 and 13, the head is drawn in frontal view. In some figures only basal segments of antennæ are drawn. The areas of cross-hatching denote the compound eyes.

ABBREVIATIONS.

a—Antenna, or basal segments of antenna.
ac—Anteclypeus.
c—Clypeus, or clypeal region.
d—Mandible.
e—Epicranial suture.
f—Frontal region.
l—Labrum, or labral region.
lp—Labial palpus, or terminal portion of labium.
m—Maxilla.
mp—Maxillary palpus.
o—Occipital region.
oc—Ocelli.
p—Genal process.
t—Tentorial or frontal pits.
x—Plical process, or point of attachment of cervical fold.
y—Line of attachment of cervical fold or plica.

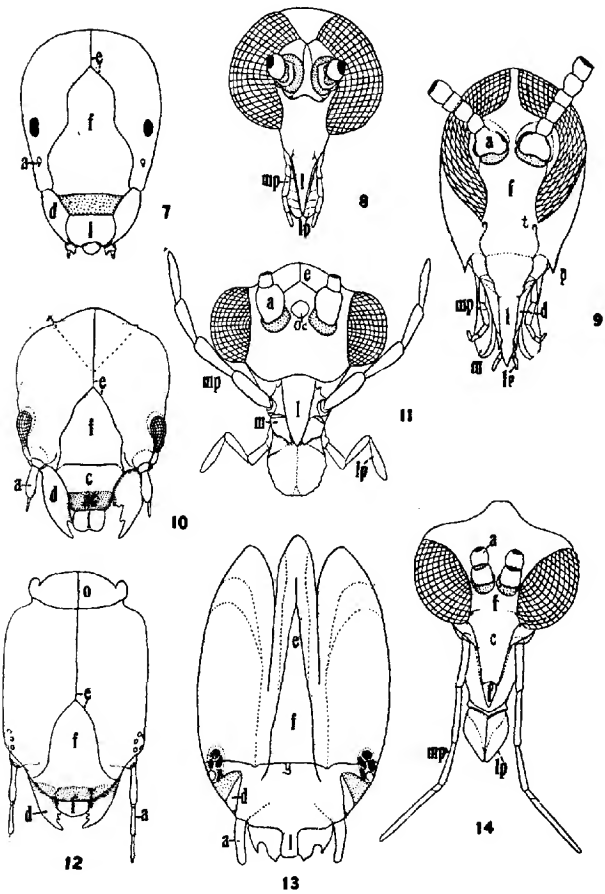

Fig. 7. Head of a larval Trichopteron.
Fig. 8. Head of the Dipteron *Heteromyia* (Ceratopogon) *trivialis*, Loew.
Fig. 9. Head of the Mecopteron *Merope tuber* (male).
Fig. 10. Head of a larval *Panorpa* (Mecopteron).
Fig. 11. Head of the Trichopteron *Neuronia*.
Fig. 12. Head of a larval *Raphidia* (Neuropteron).
Fig. 13. Head of a larval Tipulid.
Fig. 14. Head of the Dipteron *Bittacomorpha* (based upon the species *clavipes* and another *Bittacomorpha*).

series show very clearly that in the Neuroptera (among which are found certain forms which have departed but little from the ancestral condition of the Mecoptera) instead of merely one type, there are at least two developmental tendencies, the one leading to a retention of a shorter type of head, such as that of the Neuropteron shown in Fig. 1, while the other leads to the formation of a more elongate type of head, such as that of the Neuropteron shown in Fig. 4. These two tendencies are carried over, or re-appear, in the Mecoptera, which are descended from Neuropteron-like forebears. Thus the short-headed type is retained in such Mecoptera as that shown in Fig. 2 (which, however, exhibits a slight tendency toward a narrowing and lengthening of the lower portion of the head), while the tendency toward the formation of the elongate type of head appears again in such Mecoptera as that shown in Fig. 5. Similarly, in the Diptera, which in turn are derived from Mecopteron-like forebears, the same two tendencies reassert themselves, some of the Diptera having retained the short-headed type, as shown in Fig. 3, while other Diptera, such as the one shown in Fig. 6, have developed the elongate type of head.

It might be argued that a similar mode of life, or similar "environmental" conditions might cause a marked similarity in outline in the heads of the insects in question, and that this similarity is therefore due to a convergence—or rather to a parallelism of development. However, the marked morphological similarity in a series of structures taken from widely separated parts of the body (e. g. mouthparts, thoracic sclerites, legs, terminal abdominal structures, etc.) and the marked resemblance which extends even to the more minute details, and in parts which are not much used, or are not of vital importance to the organism, would preclude the possibility of a mere parallelism of development—which might possibly be the case if we were dealing with a single set of structures alone; but to argue that a parallelism of development has brought about the similarity in structure between all of these parts of the body in the series, is demanding too much of chance and the "law of probability."

While claiming that the series of insects represented in Figs. 1, 2 and 3 and the series represented in Figs. 4, 5 and 6, to all intents and purposes serve to illustrate what has actually

happened in the evolution of the head region of certain Diptera, I would not imply that recent Diptera are descended from recent Mecoptera, or that living Mecoptera are descended from living Neuroptera. On the other hand, it is quite true that living Neuroptera, Mecoptera, and Diptera have travelled together along the same developmental "road," so to speak, in following out certain evolutionary tendencies. At some point along the road, the Neuroptera branched off to follow their own path of specialization, but some of them wandered but a short distance from the main line, and have remained as little changed as certain of the fossil forms which fell by the wayside at an early date. These "conservative" individuals have preserved many features characteristic of the ancestors of the Mecoptera and Diptera who continued together for a greater distance along the road of evolution, before the Mecoptera in turn branched off to follow their own path of specialization. So too, among the Mecoptera certain individuals wandered but a short distance from the main line, and have preserved many features characteristic of the ancestors of the Diptera, and the same process was repeated when the Dipteron-like ancestors of the fleas gave rise to the Siphonaptera. The study of these "conservative" forms among living insects is quite as instructive as the study of fossil forms, and has the additional advantage of enabling one to examine the minute details not preserved in the fragmentary fossil remains, and to take into account the biological habits, etc., which are of considerable importance in an attempt to determine the relationships of the different groups of insects.

In the head region of nearly all adult Mecoptera, there is a well marked tendency toward the formation of a "genal process" or protuberance of the lower portion of the genæ ("p" of Figs. 2, 5 and 9), and it is rather strange that such a widespread tendency in the Mecoptera should not reappear in the Diptera--although the process of the genal region labeled "p" in the Dipteron shown in Fig. 6 may be homologous with the genal process of the Mecoptera. In some of the Mecoptera (Fig. 9) there is a tendency for the eyes to extend upward toward the top of the head, and downward toward the mesal line below the antennæ, and the same tendency is evident in the Diptera shown in Figs 8 and 6.

In some Diptera (Fig. 14) the contour of the upper portion of the head is more like that of certain Neuroptera (Fig. 4), while in other Diptera (Figs. 6 and 8) it is more like that of certain Mecoptera (Figs. 5 and 9). On the whole, the basal segments of the antennæ of the Diptera (Figs. 6 and 14, "a") are more like those of the Mecoptera (Fig. 5), and the resemblance between the antennal segments of the Mecopteron *Merope* and those of certain Mycetophilids and other Diptera is very striking, as I am hoping to show in a subsequent paper. In these respects, the Trichopteron shown in Fig. 11 is more like the Neuroptera than it is like the Diptera and in general the statement would hold true, that the Mecoptera approach the Dipteron type far more closely than the Trichoptera do, and are therefore in all probability much more closely related to the Diptera than the Trichoptera are, although the Trichoptera also have carried over certain "ancestral" features from the common ancestral group which gave rise both to them and to the Mecoptera and Diptera, so that they cannot be entirely disregarded in a phylogenetic study of the insects in question.

Although the labial palpi "*lp*" are much larger than the maxillary palpi "*mp*" in the "long-headed" Neuropteron shown in Fig. 4, the maxillary palpi "*mp*" are much longer than the labial palpi "*lp*" in the Neuropteron shown in Fig. 1, and in most Mecoptera (Figs. 2, 5 and 9) and Diptera (Figs. 3 and 14) this is likewise the case, as is also true, to a lesser degree, in the Trichopteron shown in Fig. 11. There is thus apparent in the Mecopteron and Dipteron stocks a marked tendency toward the reduction of the labial palpi, and the glossæ and paraglossæ tend to disappear, although I am not certain that neither paraglossæ nor glossæ are well developed in the Diptera, since Peterson, 1916, who has examined a wide range of Diptera, thinks that glossæ and well developed paraglossæ are to be found in this group. On the other hand, if one examines a specimen of *Bittacus* and *Panorpa*, it is quite evident that the maxillæ (excepting the palpi) are reduced, or have begun to unite with the labium, and that the glossæ and paraglossæ of the labium have almost disappeared, while the labial palpi have become approximated in the median line, thus assuming a condition suspiciously like that exhibited by the Dipteron shown in Fig. 6. A study of the embryological development

of the parts in question is necessary before this point can be definitely determined but the "phylogenetic" evidence would indicate that Peterson's interpretation of some of these structures may need revision. A detailed comparison of the mouthparts, accompanied by drawings of the insects in question, will be published later, as a part of the series dealing with the phylogeny of the Diptera, Mecoptera, etc., so that it is unnecessary here to do more than call attention to the tendency toward an elongation of the mouthparts exhibited by certain Neuroptera (Fig. 4), and developed to a greater extent in certain Mecoptera (Fig. 5), while it is carried to an extreme in the Culicids and other Diptera.

A comparison of the heads of the larvæ under consideration has thus far been rather disappointing, due to the fact that it is necessary to examine a far wider range of forms than is at present available, in order to select those which have preserved the desired characters—and it is largely a matter of chance whether one is so fortunate as to find these or not. I have no Culicid or Chrysopid larvæ at present, but I recall having observed in them a "cervical plica," or fold of the membranous region of the neck, which projects over the head capsule for a short distance and is attached to it at the point labeled "x" in Fig. 10 of a Panorpid larva. In some of the Trichopterous larvæ which I have examined, a similar "cervical plica" is attached to either side of the head capsule, but it is not so well developed in the Trichoptera. It is possible that a further overgrowth of the head capsule by the neck-fold mentioned above, has resulted in the condition exhibited by the Tipulid larva shown in Fig. 13, in which a fold of the neck membrane has grown over the head capsule, to which it is very closely applied, as far forward as the line labeled "y" in Fig. 13.

As far as the head region of the larvæ is concerned, the Diptera seem to be about as similar to the Neuroptera as they are to the Panorpids, and the head of a larval Panorpid is somewhat more "Neuropteron-like" than the head of a larval Trichopteron is. In the case of the adult head, however, the Diptera are closer to the Mecoptera than to the Neuroptera, and also appear to be very much closer to the Mecoptera than to the Trichoptera. In conjunction with the study of such other features as the antennæ, mouthparts, thoracic sclerites, legs,

terminal abdominal structures, etc., a comparative study of the head capsule in the insects in question would indicate that the line of development of the Trichoptera branched off from the common ancestral "Neuropteroid" stem at a point not far distant from the origin of the Mecopteron line of development. The ultimate ancestors of the Diptera were Neuropteron-like (the tendency toward the reduction of the hind wings occurring regularly in such Neuroptera as *Nemoptera*, and occasionally in such forms as *Psectra, etc.*) and they were related to both the ancestral Trichoptera and Mecoptera. The Dipteron line of development, however, has paralleled that of the Mecoptera remarkably closely (more so in fact than any other insects) and since the Mecoptera have "lagged behind," or have not travelled as far along the road to specialization as the Diptera have, they have remained in many respects strikingly like the ancestors of the Diptera, so that a study of their structures will frequently serve to indicate the steps by means of which the more highly modified homologous structures in the Diptera have reached their present state, in following out certain evolutionary tendencies present in both lines of development.

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A more complete list of the articles dealing with the mouthparts and phylogeny of the insects under consideration will be given in articles dealing with these phases of the subject.

A SYNOPSIS OF THE PETIOLATE WASPS OF THE FAMILY EUMENIDÆ (HYMENOPTERA), FOUND IN AMERICA NORTH OF MEXICO.

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The wasps of the family Eumenidæ with petiolate abdomens, found in America north of Mexico are included in two genera, *Eumenes* Latreille and *Zethus* Fabricius. The following synopsis is based on specimens contained in the U. S. National Museum. Of the genus *Eumenes* the Museum contains 11 of the 13 hitherto described species and has large series of specimens of several of these. Of the genus *Zethus* it contains specimens of all of the five described species, but the number of specimens in all species is comparatively small. In addition to the descriptions of new species included in this paper there are redescriptions of the Say and Haldeman species and of a number of other species which it seemed desirable to compare with their allies.

For the sake of clearness, descriptive terms used in this paper which are not usually used by other hymenopterists or whose usage is not always the same, may be defined as follows:

Length.—The measurement from the front to the apical margin of the second segment of the gaster.

Lateral angles of the clypeus.—The angle produced by the meeting of the apical and lateral margins of the clypeus.

Pronotal lobes.—Lobes which project from either side of the prothorax into the mesoepisternum a short distance below the tegulæ.

Metanotum.—The simple transverse plate which bears the hind wings. This is the **postscutellum** of many authors.

Propodeum.—The tergite of the first abdominal segment which has been fused to the thorax.

Gaster.—The abdominal segments after the constriction separating them from the thorax, that is, all of the abdominal segments except the propodeum.

Petiole.—The first segment of the gaster, or the **first abdominal segment** of many authors. It is not considered advisable to designate the petiole as distinct from the gaster and preceding it, for with the majority of the species of this family there is no petiole.

Apical cordon of the petiole.—The salient margin or rim at the apex of the tergite of the petiole.

Dorsal angle of the second segment of the gaster.—The median dorsal line when viewed laterally forms a more or less distinct angle which ordinarily marks the maximum inflation of the segment.

Lateral angle of the second segment of the gaster.—The lateral lines when viewed dorsally form a more or less distinct angle as does the dorsal line, which ordinarily marks the maximum lateral inflation of the segment.

The writer wishes to thank Mr. S. A. Rohwer for testing the keys to species and for criticisms and suggestions throughout the course of the studies herein presented.

The genera *Eumenes* and *Zethus* are not closely related, yet because of a superficial resemblance they can be conveniently considered together. They may be readily separated from all other wasps of the family Eumenidæ, found in America north of Mexico, by the first segment of the gaster which is petiolate, while in all other genera found within these limits it is sessile or subsessile. In turn these two genera may be separated by the following contrasting characters:

Eumenes.—Mandibles long, and sharp pointed; clypeus as long or longer than wide; head compressed transversely, not dilated behind the eyes, posterior face truncate; thorax quadrate, not strongly contracted anteriorly; prothorax nearly as wide as the head; petiole expanded, or at least not strongly contracted apically; second segment of the gaster sessile or subsessile.

Zethus.—Mandibles short, obliquely truncated; clypeus wider than long; head dilated behind the eyes, posterior face emarginate; thorax strongly contracted before the tegulæ; prothorax much narrower than the head; petiole strongly contracted apically; second segment of the gaster subpetiolate.

Genus *Eumenes* Latrielle.

The genus Eumenes as it is found in America north of Mexico forms a very homogeneous group. The differences of groups of species, however constant they may be, do not justify its division into subgenera, and it is probable that if extralimital species were studied that many of these group differences would disappear. However to facilitate the determination of species, those under consideration may be divided into four species groups, which named after the oldest species in each group are as follows: The *smithii group*, the *crucifera group*, the *fraternus group*, and the *crassicornis group*. All of these except the *crucifera group* would fall into Saussure's division Alpha.

Key to the Species of Eumenes.

1. Dorsum of the petiole impunctate.....*bollii* Cresson
   Dorsum of the petiole distinctly punctate.....2
2. Head flattened dorsally; petiole linear pyriform, without abrupt inflation, ventral aspect of the tergite sparsely punctate.....*brunneus* Isely
   Head convex dorsally; petiole pyriform or campanulate, inflation always more or less abrupt; ventral aspect of the tergite densely and coarsely punctate.....3
3. Sternite of the petiole not distinctly separated from the tergite except near the apex; dorsal line of the second segment of the gaster strongly curved forward before the dorsal angle.....4
   Sternite of the petiole distinctly separated from the tergite by a groove and a carina; the dorsal line before the dorsal angle on the second segment of the gaster not strongly curved forward.....6

4. Punctation on the ventral aspect of the tergite of the petiole extending up to the margin before the apical broadening of the sternite; a transverse brownish band crossing the middle of the dorsal aspect of the second segment of the gaster.....*smithii* Saussure
Punctation on the ventral aspect of the tergite of the petiole not extending up to the margin, except after the apical broadening of the sternite; a transverse yellowish band. (sometimes interrupted), crossing the middle of the dorsal aspect of the second segment of the gaster.....5
5. A largely brownish wasp.....*belfragei* Cresson
Brownish, replaced by yellow or golden.....*belfragei* subspecies *aureus* Isely
6. Second segment of the gaster depressed (wider than high) or if not distinctly depressed the dorsal angle is surmounted by a boss.....7
Second segment of the gaster compressed, or if not distinctly so the dorsal angle is without a boss.....10
7. Apical emargination of the clypeus shallow, but angular; second segment of the gaster with the dorsal line after the dorsal angle nearly straight with no broad transverse depression before the apex...*stenogaster* Isely
Apical emargination of the clypeus rounded; second segment of the gaster with the dorsal line after the dorsal angle recurved and with a broad transverse depression before the apex.....8
8. Second segment of the gaster beyond the lateral angles with the sides parallel, not convergent until near the apex, segment longer than wide. *boltiformis* Viereck
Second segment of the gaster beyond the lateral angles with the sides convergent, not longer than wide.....9
9. Apical cordon of the petiole not prominent, no distinct constriction immediately preceding it; abdomen largely yellow...*crucifera* Provancher
Apical cordon of the petiole prominent, with distinct constriction immediately preceding it; abdomen largely black.....*sternalis* Isely
10. Antennæ comparatively short and stout, reaching about to the tegulæ; petiole not more than twice as long as wide; sides of the prothorax before the tegulæ concave or contracted.....18
Antennæ not especially short and stout, as long or nearly as long as the thorax; petiole more than twice as long as wide; prothorax little if ever contracted before the tegulæ.....11
11. Dorsal angle of the second segment of the gaster surmounted by a boss; dorsal line recurved apically.....12
Dorsal angle of the second segment of the gaster rounded and without a boss; dorsal line not recurved apically.....13
12. Second segment of the gaster with two yellow bands, one of which is interrupted.....*cruciferorum* Viereck
Second segment of the gaster with three yellow bands, two of which are interrupted dorsally.....*tricinctus* Isely
13. Second segment of the gaster about half as wide again as the petiole. *enigmatus* Viereck
Second segment of the gaster at least twice as wide as the petiole.....14
14. Lateral angles of the clypeus about the same distance from base and apex.....15
Lateral angles of the clypeus about twice as far from the base as from the apex; surface of the clypeus coarsely punctate.....17
15. Surface of the clypeus finely punctate; petiole with lateral teeth visible when viewed dorsally; second segment of the gaster somewhat flattened dorsally, with dorsal and lateral angles distinct; markings yellowish-white.....*globulosus* Saussure
Surface of the clypeus coarsely punctate; petiole with lateral teeth not visible when the insect is viewed dorsally; second segment of the gaster convex, with dorsal and lateral angles indistinct, about a third longer than wide; markings bright yellow.....*robustus* Isely
Surface of the clypeus finely punctate; petiole with lateral teeth usually visible when viewed dorsally; second segment of the gaster convex with lateral and dorsal angles indistinct, segment short, little if any longer than wide; markings yellow.....16

16. Punctations of the first and second segments of the gaster dense; segments of the gaster largely black.....*coloradensis* Cresson
Punctations of the gaster sparse; gaster largely yellow..*xanthogaster* Isely
17. Petiole pyriform, widest at apical margin, more heavily punctate than the second segment of the gaster; markings yellowish-white; no dots on either side of the petiole.....*fraternus* Say
Petiole campanulate, widest before apical constriction, as heavily punctate as the second segment; markings of bright yellow; a dot on either side of the petiole.....*verticalis* Say
18. Sides of the prothorax before the tegulæ concave; second segment of the gaster with a broad depression before the apex extending to the sides, dorsal line strongly recurved apically, dorsal angle obtuse. *crassicornis* Isely
Sides of the prothorax contracted before the tegulæ, but convergent immediately before the anterior margin of the prothorax; depression on the second segment of the gaster not extending to the sides, dorsal line slightly recurved apically, dorsal angle near a right angle. *pachygaster* Isely

Smithii Group.

The smithii group contains brownish and yellowish species but none that are predominantly black. It differs from the others of the genus by the depth of the furrow of the propodeum, and on the ventral aspect of the petiole by the absence of carinæ along the margins of the tergite and the absence or reduction of punctations attaining these margins. *Smithii*, *belfragei* and *bollii* resemble each other in general appearance, and in particular by the shape of the clypeus and by the shape of the second segment of the gaster.

Eumenes brunneus new species.

Male.—Length, 12.5 mm.; wing, 9.5 mm. Clypeus long and narrow, lateral lines diverging but little apically, apical notch narrow, angular, surface slightly convex, not flattened apically, without brown chitinized median spot above the apex, very finely punctate; head flattened dorsally, densely punctate; thorax stout, nearly as broad as long, slightly rounded in front, strongly convex dorsally and laterally; sides of prothorax immediately before anterior margin, concave; propodeum separated with a deep median furrow; petiole elongate—three times as long as wide at the apex, pyriform, never abruptly inflated, punctations of medium depth, on ventral aspect of tergite sparse and not extending up to the margin; second segment of the gaster a third longer than wide, lateral lines divergent until nearly half-way from base then nearly parallel, transverse depression before median apical margin very slight, finely punctate, more densely apically than basally. General color ferruginous; ferrugino-testaceous on the antennæ and third to last segments of the gaster, ferruginous on the thorax and somewhat duller on the second segment of the gaster; wings subhyaline, yellowish-brown; clypeus, mandibles, anterior surface of the scape, emargination of the eyes, a post-ocular line, a wide band on the anterior

margin of the prothorax, a large patch below the tegulæ, tegulæ except a central spot, band on the anterior margin of the scutellum, metanotum, a spot on either side on the propodeum, lower half of the posterior margin of the propodeum, a wide band dorsally on the posterior margin of the petiole and narrower on the second segment of the gaster, indistinct bands on the following two segments, an indistinct cuneiform spot on either side of the second segment, ends of the femora, all of tibiæ and tarsi, yellow; median antennal segments, dorsal aspect of the head, anterior and posterior parts of the mesonotum, margins of the scutellum and the metanotum, ventral parts of the thorax, a stripe running up under the tegulæ, lower part of furrow of the propodeum, petiole except apical band, coxæ, trochanters and basal ends of femora, black. Covered with very fine golden pile.

Colorado. Described from one male.

Type: Cat. No. 21377, U. S. National Museum.

Of the North American members of this genus this species is the most distinct. In addition to the differences mentioned in the key it may be distinguished by the unusually long clypeus, the surface of which is convex, not being flattened apically, by the contrasting stoutness of the thorax and slenderness of the gaster, and the general brownish color. Because of the pyriform petiole and the absence of punctation along the ventral margin of the tergite it is placed in this group. A series of specimens including females might place it in a group by itself, but it certainly does not belong in any of the other species groups included in this paper.

Eumenes bollii Cresson.

Eumenes bollii Cresson, E. T., Trans. Amer. Ent. Soc. vol. 4, 1872, p. 232-233 - Isely, Dwight, Kans. Univ. Sci. Bul. vol. 8, 1914, p. 252-253, 299-301.

Bollii is unique among the North American species by lacking punctations on the dorsal aspect of the petiole, and is further distinguished from the others of the *smithii group* by having a campanulate petiole.

Distribution.—This species inhabits southwestern United States and there is one specimen in the U. S. National Museum labeled "Mexico." Specimens from the United States are from the following localities: Brewster Co., Del Rio, Valverde Co., and Waco, McLennan Co., Tex.; Riley Co., Kans.; Rocky Ford, Otero Co., Colo.; Des Moines, Union Co., and Sacramento Mts., Otero Co., N. M.; Huachuca Mts., Ariz.; Reno, Washoe Co., Nev.; San Berdino Co. and Stratford, Kings Co., Calif. The writer has collected it in Ness, Trego, Osborne and Norton counties, Kansas.

Type.—Cat. No. 1725, U. S. National Museum.

The writer has collected nests of this species in western Kansas. They were one-celled globular earthen nests, characteristic of this genus and were found singly attached to weed stems.

Eumenes smithii Saussure.

Eumenes smithii Saussure, Henri de, Etud. Fam. Vespid., vol. 1, 1852, p. 43, pl. 10, fig. 1; Smithson, Miscl. Coll. No. 254, 1875, p. 104-105.

All records of this species and all specimens I have seen are from Florida.

Type.—British Museum of Natural History (according to Saussure).

Nothing has been recorded previously in regard to the nest of *smithii*. In the National Museum is a nest collected by Hubbard labeled Cres City, Fla., from which a wasp of this species was reared. It is a globular earthen nest, with a jug-like mouth, typical of the wasps of this genus. The surface is more granular than that of the nests of *fraternus* and small lumps of earth give it a roughened appearance. It is attached to the lower side of a leaf.

Eumenes belfragei Cresson.

Eumenes belfragei Cresson, E. T., Trans. Am. Ent. Soc., vol. 4, 1872, p. 232.—Hartman, Carl, Jour. Animal Behavior, vol. 3, 1913, p. 353-360.

Female.—Length, 16.5 mm.; wing, 11.5 mm. Clypeus as long as wide, lateral angles comparatively near the apex, apical emargination angular, surface deeply punctate; head slightly convex above; thorax slightly rounded in front, sides convex; median furrow in propodeum deep; petiole pyriform, never as wide as at the apex, margins of tergite usually meeting ventrally, completely obliterating the sternite except at the apex, no carinæ bordering the margins, punctations on ventral aspect not attaining the margin, except at the apex; second segment of the gaster convex, longer than wide, dorsal line before angle strongly curved forward; punctations on head and thorax confluent, less dense on gaster. Largely ferruginous; dorsal aspect of the head, tips of flagella, a spot near the upper middle of the clypeus, mesonotum, lateral aspect of the thorax, basal line on metanotum, median furrow of the prepodium, basal end of the petiole, basal and central aspect of tergite of the second segment of the gaster, black, eyes dull brownish; clypeus, ridge between the antennæ, anterior emargination of the eyes, a postocular line, anterior margin of the prothorax, a large spot below the tegulæ, anterior margin of the scutellum, metanotum, a large oblique spot on each side of the propodeum, apical margin of the petiole, elongate oblique spots on either side of the second segment of the gaster meeting

dorsally, apical margin of second, third and fourth segments, ends of femora, all of tibæ and tarsi, yellow; antennæ yellowish-ferruginous; scape yellowish beneath; wings hyaline, brownish. Covered with very fine golden pile.

Male.—Length, 13.75 mm.; wing, 9.5 mm. Clypeus narrower. Clypeus, hook of the antennæ and apical margin of all segments of the gaster, yellow; oblique spots on sides of the propodeum absent.

Variations.—Margins of the tergite of the petiole do not always meet ventrally and in a few specimens the ventral punctations attain the margins of the tergite before the apical divergence. The apex of the tergite of the second segment of the gaster is often much flattened. There is considerable variation in the amount of black and the yellow oblique marks on the second segment of the gaster frequently do not meet on the dorsum.

Distribution.—Specimens in the National Museum are from Riley and Franklin Counties, Kansas; La Cuena, Mora Co., N. M.; Huntersville, Walker Co., Victoria, Victoria Co., Corpus Christi, Nueces Co., Del Rio, Valverde Co., Brewster Co., Pittsburg, Camp Co., Ladonia, Fannin Co., Greenville, Hunt Co., Calvert, Robinson Co., Dallas, Dallas Co., and Cypress Mills, Blanco Co., Texas. These localities in Texas indicate a very general distribution over the state.

Type.—Cat. No. 1726, U. S. National Museum.

This species is closely related to *smithii*, so closely that the writer has not been able with all specimens, to separate the two species except by color. The punctation character used in the key is satisfactory with most specimens, but because of a few exceptions is not entirely dependable.

Hartman has given a detailed description of the building of two nests by wasps of this species, which as far as the writer is aware is the only account of actual nest building of any American Eumenes. A few points in his account may be summarized as follows: The nests were typical jug-shaped earthen cells, attached singly to culms of Bermuda grass. Earth for building material was secured from a hard clod, or a hardened place in a path, and was moistened by water carried in the crop. The work of building was done with the mandibles and forefeet. After the base was made, a pellet of earth was spread out as a ribbon around the edge of the nest and then pulled thin to the normal thickness. Oviposition occurred before storing the nest. Geometrid caterpillars were used as food for the wasp grubs.

Eumenes belfragei sub species, **aureus** new subspecies.

Female.—Like the typical *belfragei* in structure, but differing strikingly in color, due to the replacing of black and ferruginous largely by yellowish-ferruginous and yellow. Black confined to the dorsal aspect of the head, middle of the mesonotum, base of the petiole, anterior margin of the mesosternum, posterior margin of the epimeron and base of the petiole; ferruginous on the mesonotum, petiole and second segment of the gaster, grading to yellowish-ferruginous on the sides and ventral aspect of the thorax; a narrow oblique band on either side of the second segment of the gaster, ferruginous; yellow markings the same as in the typical *belfragei*, except that the entire clypeus, the greater part of the second segment of the gaster and the following segments are yellow.

Brewster Co., Texas. Described from one female.

Type.—Cat. No. 21378, U. S. National Museum

CRUCIFERA GROUP.

This group would fall in Saussure's division Pachymenes, and includes those species with the gaster depressed, the petiole very broad and campanulate, and the wings large. The group can not be distinctly separated from the *fraternus group; bolliformis* is distinct from the species of any other group, but *stenogaster* resembles *globulosus*, while *sternalis* might be confused with *coloradensis*.

Eumenes crucifera Provancher.

Eumenes crucifera Provancher, Abbe L., Faune Hymen. de la Prov. Quebec, 1886, p. 421.

Distribution.—Specimens in the National Museum are from Los Angeles Co., Humbolt Co., Folsom, Sacramento Co., and Palo Alto, Santa Clara Co., California.

Type.—Cat. No. 1978, U. S. National Museum.

Eumenes bolliformis Viereck.

Eumenes bolliformis Viereck, H. L., Trans. Am. Ent. Soc., vol. 33, 1907, p. 387-388. Fig.

Distribution.—Flagstaff, Coconino Co., Ariz., (Viereck), and Huachuca Mts., Ariz.

Type.—Snow Collections, University of Kansas, Lawrence, Kansas.

This species superficially resembles *crucifera*, but is much larger, the gaster is proportionately wider and the second segment more depressed.

Eumenes stenogaster new species.

Female.—Length, 13 mm.; wing, 10 mm. Clypeus longer than wide, lateral angles nearer base than in *fraternus*, apical emargination moderately deep, angular, basal emargination narrow, rounded, surface coarsely punctate; thorax truncate in front, convex laterally, median furrow of propodeum deep; petiole campanulate, nearly half as wide at apex as long, punctations deep and of medium density; second segment of the gaster depressed, as wide as long, dorsal angle rounded, lateral angles attained far before the middle, beyond these angles the lateral lines are nearly parallel, punctations as on petiole. Black; clypeus, except a pediculate spot suspended from the basal margin, a line on the anterior aspect of the scape, the ridge between the antennæ, anterior margin of the prothorax, a dot on either side of the anterior margin of the mesonotum in front of the tegulæ, a spot below the tegulæ, an obscure dot on either side of the scutellum, metanotum, large oblique spots on either side of the propodeum, a large spot on either side of the petiole, a broad oblique band on either side of the second segment of the gaster nearly meeting on the dorsum, apical margins of all the segments of the gaster except the last, particularly wide on the second segment broadening into a helmet shaped spot ventrally, ends of anterior and median femora, the same pairs of tibiæ, yellow; all tarsi, ends of posterior femora and posterior tibiæ, testaceous; wings subhyaline, brownish; body covered with dense grayish pile, finer on the second segment of the gaster.

Male.—Length, 13 mm.; wing, 10 mm. Clypeus broad for a male, distinctly toothed, gaster less densely and coarsely punctate than that of the female. Clypeus all yellow, tegulæ margined with yellow; hook of antennæ, brown. Otherwise as the feamle.

Described from one female collected by C. H. T. Townsend, Rio Ruidoso, White Mts., N. M., and one male from Beaver Canyon, Utah.

Type.—Cat. No. 21379, U. S. National Museum.

Eumenes sternalis new species.

Female.—Length, 12 mm.; wing, 10 mm. Clypeus longer than wide, lateral angle little more than midway from base to apex, slightly convex, flattened apically, apical emargination rounded, basal emargination narrow and shallow, surface finely punctate; thorax convex laterally, median furrow of propodeum shallow; petiole abruptly campanulate, medium width, as wide or wider before apical contraction than after it; second segment of the gaster depressed, a little longer than wide, wide transverse depression before the apex extending to the sides, lateral angles distinct, nearer base than apex, lateral lines beyond angles converging apically; punctations on gaster shallow and of medium density. Black; clypeus except a central spot, a line on the anterior aspect of the scape, the ridge between the antennæ, a very fine postocular line, anterior margin of the prothorax, a spot below the tegulæ,

a dot on either side of the scutellum, metanotum, a spot on either side of the propodeum, an obscure dot on either side of the petiole, wide oblique bands on either side of the second segment of the gaster, apical margins of all segments of the gaster, yellow; tips of mandibles, tegulæ, and legs, testaceous. Covered with golden pile, long on head and thorax, grading to medium length on the second segment of the gaster.

Male.—Length, 11.5 mm.; wing, 10 mm. Clypeus with lateral angle near to a right angle, apical emargination angular, basal emargination deep, much like that of a *fraternus* male. Clypeus yellow.

Described from one female from Beaver Canyon, Utah, and one male from New Mexico.

Type.—Cat. No. 21380, U. S. National Museum.

Fraternus Group.

The *fraternus group* is the most homogeneous of all the groups under consideration. While it contains some large species the majority are smaller than those of the two groups previously discussed. With the exception of *cruciferorum* and *tricinctus* which are the odd members of the group, the apical emargination of the clypeus is rounded, the second segment of the gaster is without a boss on the dorsal angle and the resulting apically recurved dorsal line, which characterizes the following group and to a large extent the preceding one. All species have the second segment of the gaster convex and little depressed.

Eumenes fraternus Say.

Eumenes fraternus Say, Thomas, Narr. Long's Second Expedition, vol. 2, 1824, p. 344-346.—Harris.*, T. W., Boston Cultivator, vol. 10, 1848, p. 225.—Saussure, Henri de, Etud. fam. Vespid., vol. 1, 1852, p. 40.– Say, Thomas, Writings of Th. Say, (LeConte, J. L.), vol. 1, 1859, p. 232.—Walsh, B. D. and Riley, C. V., Amer. Ent., vol. 1, 1869, p. 138.—Riley, C. V., Second Ann. Rept. Ins. Mo., 1870, p. 103.—Couper, W., Canad. Ent., vol. 3, 1871, p. 62.—Saussure, Henri de. Smithson. Miscl. Coll., No. 254, 1875, p. 95-98.—Riley, C. V., Amer. Ent., vol. 3, 1880, p. 180.—Saunders, S., Rept. Fruit Growers Assoc. Ont., 1882, p. 281.—Provancher, L., Natural. Canad., vol. 13, 1882, p. 144, 678.—Riley, C. V., Third Rept., U. S. Ent. Comm., 1883, p. 117.– Southwick, E. B., Insect Life, vol. 5, 1892, p. 107-108.—Britton, W. E., Eighth Rept. Conn. State Ent., 1909, p. 786.—Smith, J. B., Ann. Rept. N. J. State Mus. for 1909, 1910, p. 669.—Isely, Dwight, Kans. Univ. Sci. Bul., vol. 8, 1914, p. 253-254, 301.—Viereck, H. L., Conn. State Geol. and Nat. Hist. Surv. Bul. 22, 1916, p. 635.

Eumenes fervens Saussure, Henri de, Etud. fam. Vespid. vol. 1, 1852, p. 40.

Eumenes macrops Saussure, Henri de, Etud. fam. Vespid. vol. 1, 1852, p. 41.

Eumenes minuta Saussure, Henri de, Etud. fam. Vespid. vol. 1, 1852, p. 39.

*Reference not verified by the writer.

Female.—Length, 15 mm.; wing, 11.5 mm. Clypeus convex, lateral angles two-thirds distance from base to apex, apical emargination rounded, surface coarsely punctate; head convex above; thorax convex before tegulæ; propodeum with median furrow deep, extending to the metanotum; petiole little more than one-third as wide as long, at first linear then gradually becoming pyriform, widest at apical margin, lateral teeth not visible dorsally, apical margin bordered by a salient cordon before which is a slight constriction; second segment of the gaster convex, not depressed, more finely punctate than the petiole. Black; wide basal margin of the clypeus extending forward along the sides, ridge between the antennæ, anterior aspect of the scape, a post-ocular line, anterior margin of the prothorax, metanotum, a spot on either side of the metanotum on the propodeum, apical margins both dorsal and ventral of the first and second segments of the gaster, dorsal margin of third and fourth segments, an oblique spot on either side of the second segment, a line on the lateral aspect of the tibiæ most prominent on the median pair, yellowish-white; ends of tibiæ and tarsi, piceus; outer margins of tegulæ brownish; wings brownish with violet reflections. Body covered with short, grayish pile.

Male.—Length, 12.5 mm.; wing, 10 mm. More slender than female. Clypeus widely divergent apically. Clypeus entirely and nearly all of tibiæ, yellowish-white; hook of antennæ brown; no spots on the propodeum. Otherwise as female.

Variations.—This species varies considerably in size, in the depth of the furrow of the propodeum, in the prominence of the lateral teeth of the petiole, which may be observed on a few specimens when viewed dorsally, and in the density and depth of punctation. The markings vary in prominence, particularly in males which frequently have a line on the margin of the fifth segment of the gaster, and more of the legs yellowish-white. There are two varieties with somewhat different markings, which are as follows:

Variety 1. Resembles the typical *fraternus*, except as follows: Length, 16.5 mm.; wing, 12.5 mm. Melanistic. No yellowish white on clypeus nor on legs except for a small mark on median tibæ, nor on third and fourth segments of the gaster. There is a large yellowish-white spot below the tegulæ.

Variety 2. Resembles the typical *fraternus*, except as follows: A spot below the tegulæ, spots on the propodeum very large, a dot on either side of the petiole, and apical margins of all segments of the gaster 1 to 5, yellowish white. Because of these variations in markings this variety might be confused with *verticalis*, but it differs in all structural characters. In the National Museum are only three specimens so marked.

Distribution.—The writer has seen specimens of the typical *fraternus*, most of which are in the National Museum, from the following localities: Durham, Stafford Co., N. H.; Forest Hills and Boston, Mass.; Lake George, Warren Co., and Long Island, N. Y.; Carlisle Junction, Craighead and Eberly Mills,

Cumberland Co., Campbell, York Co., Heckton Mills, High Spire and Rockville, Dauphin Co., North East, Erie Co., Martic Forge, Lancaster Co., and Philadelphia, Pa.; Cabin John and Plummers Island, Montgomery Co., and Linwood, Carroll Co., Md.; Washington, D. C.; Chain Bridge, Alexandria Co., Dixie Landing, Pohick Run, Newington, and Mt. Vernon, Fairfax Co., Va.; Highlands, Macon Co., N. C.; Jacksonville, Duval Co., Fla.; Holly Springs, Marshall Co., Miss; Lake Charles, Calcasieu Co., La.; Mich.; Corydon, Harrison Co., Borden, Clark Co., and Noblesville, Hamilton Co., Ind.; Riley Co. and Lawrence, Douglas Co., Kans.; West Cliff, Custer Co., Colo.; Dallas, Dallas Co., Denton, Denton Co., Paris, Lamar Co., Victoria, Victoria Co., and Wolf City, Hunt Co., Texas; in the United States and one specimen labeled Canada.

Specimens of the melanistic variety, (No. 1) are from New Orleans, La.; Jacksonville, Duval Co., Fla.; and Victoria, Victoria Co., Texas.

All specimens of variety No. 2 are labeled New Jersey.

To the states listed above, Connecticut may be added, as the species is recorded from that state by both Viereck and Britton.

Neotype.—Determined by the writer. U. S. National Museum.

This species is larger and more slender than any other belonging to this group and the petiole is pyriform while with the others it is more or less distinctly campanulate. In these respects it resembles the species of the *smithii group.*

Fraternus is the commonest of the American species and its habits are the best known. Accompanying Say's original description of the species is also a description of the globular nest with the opening terminated by a jug-like mouth. The nest has subsequently been described by a number of observers, and is known to occur singly or in groups of 2 to 5, on the surface of stones or leaves or attached to twigs or weed stems. Lepidopterous larvæ are stored as food for the wasp grubs. According to Say they store nocturnal Lepidoptera; Harris records the storing of canker-worms (*Anisopteryx vernata* Peck.); Norton in a note in Saussure's Synopsis records the storing of green diurnal Lepidoptera; Southwick describes the destruction of the parsnip web-worm (Depressaria heraclina De G.)

Eumenes verticalis Say.

Eumenes verticalis Say, Thomas, Narr. Long's Second Expedition, vol. 2, 1824, p. 346.—Saussure, Henri de, Etud fam. Vespid. vol. 1, 1852, p. 41.—Say, Thomas, Writings of Th. Say (LeConte, J. L.), vol. 1, 1859, p. 233-234.

Female.—Length, 11.75 mm.; wing, 9.25 mm. Similar to *fraternus*, from which it differs as follows: Thorax stouter, furrow of the propodeum shallow, scarcely reaching the metanotum; petiole and second segment of the gaster wider in proportion to length than those of *fraternus*, petiole distinctly campanulate, widest before apical constriction, apical constriction and apical cordon more pronounced than with *fraternus;* second segment of the gaster about as coarsely punctate as the first. Black, but less shining than *fraternus;* basal half of clypeus extending forward along the sides, greater part of the tegulæ, a spot below the tegulæ, an oblique mark on the propodeum on either side of its jointure with the petiole instead of higher on either side of the metanotum as in *fraternus*, apical margins dorsal and ventral of all segments of the gaster from one to five, a dot on either side of the petiole, an elongate oblique mark on either side of the second segment of the gaster instead of a spot, ends of femora and greater part of tibia, and all other markings found on *fraternus*, bright yellow instead of yellowish white; tarsi testaceous; center of tegulæ rufous; wings brownish. Covered with pile of medium length.

Male.—Length, 10 mm.; wing, 7.5 mm. Clypeus entirely yellow; no spot below the tegulæ nor on the propodeum. Otherwise like the female.

Variations.—The amount of yellow on the clypeus is variable. The spot below the tegulæ is absent on about half the specimens at hand, one lacks the marks on the propodeum and another lacks the dots on the petiole. The yellow on the segments of the gaster varies with individuals.

Distribution.—The species was described by Say from Pennsylvania. The National Museum contains specimens from the following localities: Forest Hills, Suffolk Co., Mass.; Philadelphia, Pa.; Chain Bridge and East Falls Church, Alexandria Co., Va.; Ind.; Mo.; Volga, Brookings Co., S. D.; and West Cliff, Custer Co., Colo.

Neotype.—Determined by the writer. U. S. National Museum.

This species is often confused with *fraternus* in collections, with which Dalla Torre (Catalog. Hymen; vol. 9, 1894, p. 33), suggests that it is a possible synonym. The two species are readily separated by their difference in size, by the structure of the first and second segments of the gaster, by the color and color pattern.

Eumenes globulosus Saussure.

Eumenes globulosus Saussure, Henri de, Etud. fam. Vespid. Supplement, 1859, p. 139; Smithson. Miscl. Coll., No. 254, 1875, p. 101-102.—Smith, J. B., Ann. Rept. N. J. State Mus., for 1909, 1910, p. 669.

Female.—Length, 13.5 mm.; wing, 10 mm. Like *fraternus* from which it differs as follows: Clypeus with lateral angles slightly nearer apex than base, apical emargination more shallow, surface finely punctate; furrow in the propodeum inconspicuous, not extending upward to the metanotum; petiole campanulate, nearly half as wide as long, lateral teeth visible dorsally, no conspicuous contraction before the apical cordon; second segment of the gaster nearly as wide as long with the dorsal angle abrupt, more flattened dorsally and more finely punctate than *fraternus*. Black; larger part of clypeus, a spot on the tegulæ, a spot below the tegulæ, the spot on either side of the second segment of the gaster elongated into an oblique line, apical margins of all segments of the gaster 1 to 5, yellowish-white; ends of tibæ, tarsi and wings brown. Covered with grayish pile of medium length and density.

Male.—Length, 10 mm.; wing, 8.25 mm. Differs from the female as follows: More slender, clypeus narrower, with lateral angles less prominent than those of *fraternus*. Clypeus entirely, and the margin of the sixth segment of the gaster and more surface of the legs, yellowish-white. Spots below the tegulæ and on the sides of the propodeum absent.

Distribution.—The range of this species overlaps that of *fraternus* and extends north of it. Saussure records it from Illinois and Wisconsin in the United States and from Great Slave Lake in Canada. In the National Museum are specimens labeled as follows: Waldoboro, Lincoln Co., Me.; Durham, Strafford Co., N. H.; Mass.; N. J.; Ind. and Mich; in the United States, and Montreal, Province of Quebec, and a number of other specimens simply labeled Canada.

Type.—Probably in the Museum of Geneva, Switzerland.

Like *verticalis*, this species is frequently confused with *fraternus*. In many respects it is much like both of the above species and also like *coloradensis*. The clypeus in general shape and in its fine punctation resembles *coloradensis* rather than *fraternus* or *verticalis*. The campanulate petiole resembles that of *verticalis* and *coloradensis*, while the prominence of the teeth of the petiole resembles that of *coloradensis* and is unlike that of the others. It resembles *fraternus* and differs from the other two by having the second segment of the gaster less distinctly punctate than the petiole, by the shining black color and markings of yellowish-white, instead of bright yellow.

The color pattern, however, is more like that of *verticalis* and on none of the four species are the markings as extensive as on *coloradensis*. *Globulosus* is unique among the four species by the failure of the furrow of the propodeum to extend upward to the metanotum and by the broader and more depressed second segment of the gaster.

Eumenes coloradensis Cresson.

Eumenes coloradensis Cresson, E. T., Rept. Geog. and Geol. Surv. West of the 100th Meridian, vol. 5, 1875, p. 717-718.

Distribution.—Described from Colorado. In the National Museum are specimens from West Cliff, Custer Co., Colo.; Beulah, San Miguel Co., Hell's Canyon and White Mts., N. M.; and Beaver Canyon, Fremont Co., Idaho.

Type.—In Museum of the Philadelphia Academy of Natural Sciences. (According to Cresson).

Eumenes xanthogaster new species.

Male.—Length, 10.75 mm.; wing, 8.25 mm. Clypeus narrow, lateral angles obtuse, almost as near to base as to apex, apical emargination rounded, basal emargination deeper than that of *fraternus*, surface finely punctate; thorax truncate in front, convex laterally; furrow of propodeum of moderate depth; petiole campanulate, widest before apical constriction, inflation more abrupt than that of *fraternus*, lateral teeth not visible from above, punctations deep and sparse, second segment of the gaster as wide as long, dorsal and lateral lines convex, punctations finer than on first segment becoming more dense apically. Black; clypeus, anterior aspect of the scape, ridge between the antennæ, a very short post-ocular line, anterior margin of the prothorax, outer margin of the tegulæ, a spot below the tegulæ, a spot on either side of the scutellum, metanotum, a spot on either side of the petiole, a narrow band on the apex, on the second segment of the gaster large elongate lateral spots nearly meeting dorsally and confluent with the wide apical band, ventrally the apical two-thirds of the second segment of the gaster, and the succeeding segments, both dorsally and ventrally, except basal black bands, yellow; ends of femora, all of tibiæ and tarsi, testaceous; wings brownish. Pile very fine on clypeus, long on the dorsal aspect of the head and thorax, and grading to fine on the second segment of the gaster.

Los Angeles Co., Calif. Described from three males collected by the late D. W. Coquillet.

Type.—Cat. No. 21381, U. S. National Museum.

This species is closely allied to *coloradensis* but in addition to the characters mentioned in the key it may be distinguished

by the smaller lateral teeth on the petiole which can not be seen when the insect is viewed dorsally, and by the slightly shorter second segment of the gaster.

Eumenes robustus new species.

Female.—Length, 13.5 mm.; wing, 11.25 mm. Clypeus longer than wide, lateral angle midway between base and apex, apical emargination rounded and very shallow, surface densely and coarsely punctate; thorax convex; propodeum with median furrow shallow; petiole campanulate but not distinctly so, linear for nearly half its length then becoming comparatively wide, widest at apex, lateral teeth not visible dorsally; second segment convex when viewed either dorsally or laterally, angles not distinct; punctations of the petiole of medium coarseness and density, finer and sparser on the second segment. Black; clypeus except a central spot, a line on the anterior aspect of the scape, a ridge between the antennæ, anterior margin of the prothorax, tegulæ except a central spot, a spot below the tegulæ, a spot on either side of the scutellum, metanotum, a spot on the propodeum on either side of the metanotum, a spot on either side of the petiole, a large oblique cuneiform spot on either side of the second segment of the gaster, apical cordon of the petiole, wide apical margin of the second segment both ventral and dorsal, and the succeeding segments except the basal margins of the sternites, legs beyond the bases of the femora, yellow; a spot in the center of the tegulæ, rufous; wings hyaline with golden reflections. Body covered with fine golden pile.

Male.—Length, 13.5 mm.; wing, 11 mm. Clypeus narrow, with lateral angle much nearer apex than base, yellow; hook of antennæ, brown; no yellow on propodeum. Otherwise as female.

Described from one female from Beulah, San Miguel Co., N. M.; and from one male from Williams, Coconino Co., Ariz. The National Museum also has specimens from Ft. Collins, Larimer Co., Colo. and from Oregon.

Type.—Cat. No. 21382, U. S. National Museum.

Although not as long as *fraternus* this species is the most robust in the group. This character and the distinct markings readily distinguish this species from any of the others.

Eumenes enigmatus Viereck.

Eumenes enigmatus Viereck, H. L., Trans. Am. Ent. Soc., vol. 33, 1908, p. 389, pl. 12.

Distribution.—Flagstaff, Coconino Co., Ariz. (Viereck); Ornsby Co., Nev.; Boulder Co., and Florissant, Teller Co., Colo.

Type.—Snow Collections, University of Kansas, Lawrence, Kansas.

Eumenes cruciferorum Viereck.

Eumenes cruciferorum Viereck, H. L., Trans. Am. Ent. Soc., vol. 33, 1908, p. 388-389, pl. 13.

Distribution.—Flagstaff, Coconino Co., Ariz. (Viereck); Pecos, San Miguel Co., N. M.

Type.—Snow Collections, University of Kansas, Lawrence, Kansas.

Eumenes tricinctus new species.

Female.—Length, 11 mm.; wing, 8.5 mm. Clypeus slightly longer than wide, apical emargination of moderate depth, obtusely angular, basal margin slightly incurved, punctations shallow and dense; thorax truncate in front, sides between anterior margin and tegulæ little convex; furrow of propodeum shallow; petiole campanulate, two-fifths as wide as long, inflation gradual beginning about halfway from base; second segment of the gaster longer than wide, dorsal and lateral lines convex, dorsal angle surmounted by a boss or hump making it higher than the apical part of the segment, dorsal line recurved apically, depression before apical margin wide extending to the sides; punctation on the gaster medium. Black; clypeus except a black spot in the center, a ridge between the antennæ, a line on the anterior aspect of the scape, a post-ocular line, a band on the anterior margin of the prothorax, oblique bands on the anterior margin of the mesonotum, tegulæ, spots below the tegulæ, anterior half of the scutellum, metanotum, convexities of the propodeum, a large spot on either side of the petiole confluent with the band on the apical margin, three wide bands on the tergite of the second segment of the gaster, two of which are interrupted medially, the apical one entire, the ventral part of the segment and all of the succeeding segments except basal black bands, ends of femora and all of tibiæ, yellow; tarsi, testaceous; wings, hyaline, brownish; pile long on the head and thorax grading to fine on the second segment of the gaster.

Oregon. Described from two females. The National Museum also has one specimen from Los Angeles Co., California.

Type.—Cat. No. 21383, U. S. National Museum.

This is a slender wasp, closely related to *cruciferorum*.

CRASSICORNIS GROUP.

These two species are readily distinguished from the others discussed in this paper by their general stoutness, the thick, short antennæ, the stoutness of the thorax and the gaster, and the abruptness of the dorsal angle and the recurved dorsal line of the second segment of the gaster. They are related to *iturbide* Saussure.

Eumenes crassicornis new species.

Male.—Length, 11.5 mm.; wing, 9 mm. Clypeus very wide for a male, as wide as long, apical emargination angular, basal margin slightly incurved, punctation medium; antennæ comparatively short and stout, reaching back to tegulæ; thorax stout, truncate in front, sides of prothorax from anterior margin to tegulæ concave; furrow of the propodeum wide and deep; petiole only twice as long as wide, much the widest at the apex with no distinct contraction before it, comparatively flat, punctations medium; second segment of the gaster as wide as long, convex dorsally, dorsal angle abrupt, dorsal line strongly recurved apically, transverse depression before the apex extending to the sides, punctations fine and of medium density. Black; a wide median, longitudinal band covering two-thirds of the surface of the clypeus, a dot between the antennæ, a fine post-ocular line, anterior margin of the prothorax, posterior margin of the tegulæ, a line on the posterior of the metanotum, a very small dot on either side of the first and second segments of the gaster, dorsal apical margin of the segments of the gaster one to four, and the ventral margin of the second segment, a longitudinal band on the anterior tibiæ, ends of femora and all of tibiæ of middle and posterior legs, yellow; hook of antennæ, tegulæ, tarsi and wings, brown. Grayish pile, tinged with golden, long and dense on the head and thorax, shorter on the petiole and fine on the second segment of the gaster.

Goldstream, British Columbia, Dominion of Canada. Described from one male specimen. The National Museum has also one specimen from Seattle, Wash.

Type.—Cat. No. 21384, U. S. National Museum.

This species is the most nearly black of any known to the writer within the geographical limits prescribed by this paper. It is the only male with black on the clypeus, and the only species besides pachygaster lacking the yellow ridge between the antennæ and the line on the scape, while the dots on the sides of the second segment of the gaster are so obscure that they might readily be missed altogether.

Eumenes pachygaster new species.

Female.—Length, 11.5 mm.; wing, 9 mm. Clypeus as long as wide, apical margin nearly truncate, with slightly rounded emargination, punctations of medium depth and sparse; antennæ comparatively short and stout, reaching back about to the tegulæ; thorax truncate in front, sides convex, but contracted immediately before the tegulæ; furrow of the propodeum not deep; petiole short, less than twice as long as wide at the apex, campanulate with distinct contraction before the apex, punctation of medium depth and distribution extending to the ventral margins of the tergite; second segment of the gaster almost cubical,

wider than and as high as long, dorsal angle near to a right angle, dorsal line recurved apically, transverse depression before the apex broad, but not extending to the sides, punctations fine and of medium density. Black; basal third of clypeus, a spot between the antennæ, a post-ocular line, anterior margin of the prothorax, the greater part of the tegulæ, metanotum, a spot on either side of and below the metanotum on the propodeum, a dot on either side and the margin of the petiole, a wide oblique line on either side of the second segment of the gaster, posterior margins of the second to fifth segments, a dot on either side of the apical margin of the sternite of the second segment, tips of the femora and a band on the tibæ, yellow; a spot on the tegulæ, and tarsi, brown; wings, hyaline, brownish. Pile grayish, fine and sparse on clypeus, dense on the scape, long and dense on the head, medium on thorax and gaster.

Mountain View, Santa Clara Co., Calif. Described from three females collected by W. H. Ashmead. These specimens were marked as a new species by Dr. Ashmead. In the National Museum is another specimen from Menlo Park, San Mateo Co., Calif.

Type.—Cat. No. 21385, U. S. National Museum.

Species not Included in the Above

There are two described species which are found within the geographical limits prescribed for this paper, which the writer has not seen, for which reason they are not included in the tables and discussion of species. They are as follows:

Eumenes marginilineatus Viereck.

Eumenes marginilineatus Viereck, H. L., Trans. Am. Ent. Soc., vol. 33, 1908, p. 381.

Distribution.—Estes Park, Larimer Co., Colo. (Type locality).

Type.—Snow Collections, University of Kansas, Lawrence, Kansas.

Eumenes globulosiformis Viereck.

Eumenes globulosiformis Viereck, H. L., Trans. Am. Ent. Soc., vol. 33, 1908, p. 386-387.

Distribution.—Thomas' Ranch, Oak Creek Canyon, near Flagstaff, Coconino Co., Ariz. (Type locality).

Type.—Snow Collections, University of Kansas.

Genus *Zethus* Fabricius.

The five representatives of this genus found in America north of Mexico are readily divided into two groups which may be called after the oldest species in each, the *spinipes group* and the *poeyi group*. The first would fall into the Division *Zethusculus* Saussure and the second into the Division *Didymogastra* Perty. Saussure regarded the separation of the latter division from the former, which was based on the different lengths of the subpetiole, as "entirely empirical and should not be preserved except to facilitate the determination of species." However with the limited number of species covered by this paper the two groups are quite distinct.

Key to the Species of Zethus.

1. Robust species; clypeus triangular; depth of head behind the eyes greater than before their hind margin; concavity of the propodeum wide; small spines on the lateral aspect of the middle and posterior tibiæ; petiole constricted apically, gaster black or blackish (*spinipes group*).....2
   Slender species; clypeus oval; depth of head behind the eyes less than before their hind margin; concavity of the propodeum not pronounced; no spines on the lateral aspect of the tibiæ; petiole much narrowed, but not constricted apically; gaster after the subpetiole reddish (*poeyi group*)..4
2. Petiole half as wide as long, greatest width nearer the apex than the base; area on the mesonotum adjacent to the tegulæ not distinctly defined, sparsely punctate.....3
   Petiole much more inflated, two-thirds as wide as long, greatest width nearer the base than the apex; area on the notum adjacent to tegulæ distinctly defined and impunctate.....*substricta* Haldeman
3. Pronotal lobe impunctate basally; little yellowish on dorsal aspect of the thorax.....*spinipes* Say
   Pronotal lobe densely punctate basally; much yellowish on the dorsal aspect of the thorax.....*variegatus* Saussure
4. Clypeus without teeth apically.....*poeyi* Saussure
   Clypeus with three teeth apically.....*slossonæ* Fox

Zethus spinipes Say.

Zethus spinipes Say, Thomas, Bost. Jour. Nat. Hist., vol. 1, 1837, p. 387-388.—Saussure, Henri de, Etud. fam. Vespid., vol. 3, 1854, p. 122.—Say, Thomas, Writings of Thomas Say, (LeConte, J. L.), vol. 2, 1859, p. 767.—Saussure, Henri de, Smithson, Miscel. Coll. No. 254, 1875, p. 29.

Eumenes pennsylvanica Haldeman, S. S., Proc., Phila. Acad. Sci., vol. 6, p. 365.

Female.—Length, 14.75 mm.; wing, 12.5 mm. Mandibles 4-toothed, first tooth distinctly longer than the second; clypeus roughly triangular, nearly twice as wide as long, basal margin narrow, concave, sides slightly convex, somewhat indented by the insertion of antennæ, and widely divergent apically, apical lateral margin not distinctly separated from the genæ, apical margin truncate, with two small teeth, surface strigose in median portion, coarsely punctate elsewhere; small carinæ on inner margins of insertion of antennæ, area between the antennæ strigose; head greatly inflated behind the eyes, deeper behind the eyes than before their hind margin; pronotal lobe impunctate; mesonotum

with a median carina extending backward from the anterior margin, and two impressed lines extending forward from the posterior margin dividing it into three equal parts; adjacent to the tegulæ is a sparsely punctate area indistinctly defined by an impressed line; scutellum divided by a median impression; petiole twice as long as wide, at first linear then inflated, greatest width distinctly nearer apex than base, apical cordon distinct with three depressions immediately before it, deeply but not densely punctate; second segment of the gaster subpetiolate, nearly as wide as long, tergite finely and sparsely punctate, sternite finely and comparatively densely punctate; lateral aspect of median and hind tibiæ with irregular rows of spines. Black; a spot on the clypeus on either side of the basal margin, carinæ on inside margin of the insertion of the antennæ, an indistinct mark on either side of the anterior margin of the prothorax, apical margin of the tegulæ, a dot on either side of the metanotum, apical cordon of the petiole, margin of the second segment of the gaster, yellow; legs becoming brownish toward tarsi; wings brownish with violet reflections.

Distribution.—Originally described from Indiana. Saussure records its distribution as follows: Conn., Pa., Ill., Tenn., Ind. and Fla. The neotype is from Harrison Co., Ind., collected by Harold Morrison. The National Museum also contains other specimens from Washington, D. C.

Neotype.—Determined by the writer. U. S. National Museum.

Zethus variegatus Saussure.

Zethus variegatus Saussure, Henri de, Etud. fam. Vespid., vol. 1, 1852, p. 13-14, Rev. and Mag. Zool., vol. 10, 1858, p. 66.

Zethus bicolor Saussure, Etud. fam. Vespid, vol. 1, 1852, p. 17.

Zethus spinipes, var. *variegatus* Saussure, Smithson. Miscel. Coll., No. 254, 1875, p. 30.

Female.—Length, 14.5 mm.; wing, 12.5 mm. Differs from *spinipes* as follows: Pronotal lobes densely punctate basally. Dorsal aspect of the prothorax, a large spot under the tegulæ, scutellum except margins and the median line, metanotum, large spots on the convexities of the propodeum, wide apical margin of the tergite of the petiole, apical margins of the tergites of the second and third segments of the gaster, and the ventral margin of the second segment, yellowish; legs brownish.

Male.—Length, 13.75 mm.; wing, 10.25 mm. Differs from the female as follows: More slender. Clypeus punctate, not rugose, yellow except lateral and basal margins; antennæ hooked.

Distribution.—Originally described from Pennsylvania. Specimens in the National Museum are from the following localities: Md; Va; S. C; Tifton, Tift Co., Ga; and Victoria, Victoria Co., Dallas, Dallas Co., Texas; and Washington, D. C.

Type.—According to Saussure in the collection of M. de Romand.

The color differences between this species and *spinipes* are striking, and as far as the writer has observed, there is no tendency for the markings to intergrade. This wasp was first described by Saussure, although he later regarded it as a color variety of *spinipes*. While the writer might hesitate to establish a new species based on characters of punctation and color with a small series, yet since the species has been named it would seem preferable to preserve the name until the characters upon which it is based are shown to be unstable.

Zethus substrictus Haldeman.

Zethus substrictus Haldeman, S. S., Proc. Phila. Acad. Nat. Sci., vol. 2, 1844, p. 54.—Saussure, Henri de, Etud. fam. Vespid., vol. 3, 1854, p. 152.

Zethus spinipes var. *substrictus*, Saussure, Henri de, Smithson. Miscel. Coll., No. 254, 1875, p. 30.

Female.—Length, 16.5 mm.; wing, 13.75 mm. Differs from *spinipes* as follows: Mesonotum with median carina more distinct, area just within tegulæ distinctly defined by a depressed line, impunctate; petiole two-thirds as wide as long, sublinear at basal end and then rapidly inflated, greatest width nearer base than apex, apical cordon distinct with only one depression before it, punctations less distinct; second segment of the gaster longer after the subpetiole. Black; no spots on the clypeus and metanotum; a line on either side of the anterior margin of the prothorax instead of an indistinct mark, a spot on either side below the tegulæ, a spot on either side of the furrow of the propodeum, yellow; antennæ beyond the scape and all of legs, brownish.

Male.—Length, 13.75 mm.; wing, 10.5 mm. Differs from the female as follows: Basal line of the clypeus wider and more nearly truncate, surface punctate and not strigose, petiole more slender. Black; apical half of clypeus, anterior aspect of the scape of the antennæ, apical margin of the third segment of the gaster, yellow; antennæ, gaster and tegulæ, brownish; no spot on the anterior margin of the prothorax, below tegulæ, nor on propodeum.

Distribution.—Pennsylvania and Long Island, New York.

Neotype.—Determined by the writer, in the U. S. National Museum.

Zethus poeyi Saussure.

Zethus poeyi Saussure, Henri de, Rev. and Mag. Zool., vol. 9, 1857, p. 270; Smithson. Miscel. Coll., No. 254, 1875, p. 45-47.

Distribution.—Cuba. (Saussure). The National Museum has three specimens from Tavenier, Largo Key, Fla., collected by Frederick Knab.

Type.—Probably in the Museum of Geneva, Switzerland.

Zethus slossonæ Fox.

Zethus slossonæ Fox, W. J., Ent. News, vol. 2, 1892, p. 29-30.

Distribution.—Punta Gorda, De Soto Co., (Fox), Jacksonville, Duval Co., Miami, Dade Co., Fla.

Type.—Cat. No. 1855, U. S. National Museum.

HOLOLEPTINÆ OF THE UNITED STATES.*

By F. G. Carnochan.

Section I.

The Hololeptinæ in the United States comprise the genera *Hololepta*, subdivided into *Hololepta* and *Leionota* and *Iliotona* (n. gen.). The name Leionota, amended to Lionota by Marseul, requires comment. *Leionota* was proposed by Dejean as a genus of Histeridæ in the so-called first edition of his catalogue in 1821 (really the second); this division was retained in his catalogues of 1833 (the date usually assigned to the name), and 1837. Under this name he cited several species of which only two *Hololepta quadridentata* Fab. and *H. lamina* Payk. were described species; this citation would ordinarily fix the genus with one of the included described species as type, but Marseul in 1853 pointed out, after a study of the Dejean collection, that the species assigned by Dejean to *quadridentata* Fab. was not that species, but another which he described as *devia*, and that the species *lamina* was not Paykull's species but *minuta* of Erichson. The mere fact that the specimens which Marseul saw were misidentified does not invalidate the name. We have only published records to go by, and misidentification cannot be absolutely proved. Marseul in 1853 used the name *Leionota* for the same division, and in 1857 changed it to Lioderma. The name of the subgenus should therefore be Leionota and is ascribed to Dejean with a date of 1821 with *Leionota quadridentata* Fab. as type, as one of the forms included in the original citation, the name *Lioderma* becomes a synonym.

The life history and habits of the members of this subfamily are very little known. The egg is unknown, but probably closely resembles the eggs of the members of the other subfamilies; I have figured the egg of *Hister obtusatus* Harris (Pl. XXX, Fig. 3). This egg is similar in shape and appearance to the eggs of *Saprinus* and *Hetærius*, white, opaque and minutely roughened, about two millimeters long. Examination of the ovaries of various Histerids, and observations show that the eggs are ripened one at a time and are laid at appreciable

*Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 134.

intervals of time; in the genus Hister the interval varies from three to eight days, in Saprinus it is less, usually about one day. I append figures of the ovaries of *Hister obtusatus* Harris, *Saprinus pennsylvanicus* Payk. (Pl. XXX, Figs. 4-5), which show the periodic ripening of the eggs. The early stages of the larva are not known, but the last stage of Hololepta æqualis Say may be briefly described as follows:

Hololepta æqualis Say. Plate XXVIII, XXIX.

Larva. Wickham. American Naturalist, XXVIII, p. 816, 1894.

Length 14-16 mm. Flattened, white.

Head strongly chitinized, quadrate, chestnut brown. Dorsally, with a shallow transverse impression about one-third from the anterior margin to the posterior border, two punctures on this impression, behind them and out side of them two more, and behind these two and inside of them two more, a line connecting all these punctures would form an almost regular octagon; behind each antenna and forming the arc of a circle with the center towards the antennæ, three punctures. Clypeus quadrate, broader than long. Antennæ inserted posterior to the mandibles at the anterior corners of the head,* first external segment long, cylindrical, second a little more than half the length of the first, dilated at apex; third short, half the length of the second, narrowly cylindrical, the whole antenna almost as long as the head. Mandibles stout, curved, with a stout tooth a little more than halfway from the apex, on the inner margin; when closed the left mandible overlaps the right. Ventrally, the head has behind the labium a cordate shaped impression, at the anterior margin of which there is a boss, another boss occurs near the base, and connected to this impression at the base there is a deep spear-shaped puncture; near the lateral borders on a line with this puncture there is on each side a shallow puncture. Maxillæ inserted at the base of the mandible near the interior border, the dorsal surface of the first visible segment concave longitudinally; inner margin of the same segment fringed densely, outer margin lightly fringed and with a single long bristle on the apical fourth, second segment the

*Dissection shows the antenna to be inserted on a process next to the superior external basal corner of the mandibles, the true first joint. The antenna has four true joints.

length of first, one quarter the length of first, with a short segment on the inner margin which bears a single bristle. Third and fourth segments together a little longer than the second, and equal in length to the fifth, third segment slightly shorter than fourth. Labium with two jointed palpi, the first joint of which is half the length of the second. Pronotum as large as head, corneous with a deep median longitudinal furrow, the center portion, triangular, the base of the triangle towards head, deep chestnut brown, remainder light brown, a single bristle on each side before the middle. Prosternum corneous with seven differentiated areas, the center one triangular, with the apex of the triangle towards the head, yellow brown; on each side of this center area, a triangular area whose base is towards the head, of the same color, outside of this a rhomboidal area of lighter color, and posterior to the rhomboidal area, a white area which carries the coxæ.

Meso- and metathorax short, one-third the length of the prothorax. Mesonotum colored for its entire width, metanotum with a broad band for almost the entire width, and a smaller area at each edge, sternites with three markings; a broad band across the center to the lateral halves, and at each end of this band a smaller area, all colored light brown. Each segment with a single marginal bristle.

Nine abdominal segments are present, the first with two complete transverse rows of ambulacral hooks dorsally, and between each row the same arrangement of colored patches in threes as on the metathorax. All the remaining segments, except the ninth which bears none, have three rows of hooks, and between each row the same arrangement of plates. On the fold between the segments, on each side between the center and the lateral colored areas, there is a small group of hooks arranged in the arc of a circle whose center lies posterior; behind the last rows of hooks on the segments themselves and directly anterior to the small group mentioned above there is a single seta with a few hooks around it. Ninth segment with a pair of cerci, each composed of a basal tubercle which bears a single bristle, a first segment which is stout and clavate with a pair of stout bristles below the insertion of the second segment which is one and one-half times as long as the first segment, and half as wide, and bears at its apex a pair of strongly diverging bristles. On the lateral margins of the abdominal

segments are paired bristles, rising from tubercles, and on all the segments except the first there is, under the first of these bristles, another stout bristle on all the segments except the ninth where it is reduced in size and comes under the posterior bristle of the two, on the ventral surface. On the ventral surface each segment bears three rows of ambulacral hooks except the ninth which has none, and the eighth which has two complete rows, the first row broad and entire, the second short, interrupted at middle, the third entire and forked at each end. The ninth segment has the anal region developed into a pseudopod. Spiracles biforian, on the mesothoracic, and all abdominal segments except the ninth. Legs composed of a cylindrical coxa, which bears two bristles on its inner margin, a trochanter, cylindrical, short, a femur three times as long as the trochanter, a tibia two-thirds the length of the former and a claw; the claw bears a short accessory spine (visible only at high magnifications).

I am unable to see under the highest magnification the rudimentary tarsus which Schiodte (1864) figures. The spine on the claw resembles the figure given by Schiodte for *Platysoma depressum*. These larvæ have great difficulty in crawling unless they can bring the dorsum into contact with something. The hooks, which in the description I called "ambulacral," are used by the larva to push itself along. The larva, in moving, draws up the anal pseudopod and places it; then the segments move forward in rhythmical order, the hooks serving to attach each segment while the next one in front of it is moving forward. The larvæ are very voracious carnivores, living on the larvæ of an anthomyid fly, and an ortalid fly, eating from six to fifteen a day.

When the larva is full grown it sets itself to work to make the pupal cell, travelling as much as an inch for material, shredded wood, cotton, filter paper, anything available which it can chew up; the natural material is finely chewed wood. The wood is cemented together with an anal secretion, and it is not uncommon to see the larva reach to its anus with its head and apply the secretion gathered to the wall of its cell. I believe that the clypeus and frons are used for carrying the secretion and the clypeus and mandibles used as trowels to spread it. The larva begins by forming a ridge of transported material, then adds to the cell by adding pieces to each side

of the ridge. These are laid near the position desired and pushed into place with head and mandibles. Every little while the animal stops transporting material, wets the whole mass, pushing it into place with head and body. The last portion of the pupa case to be finished is the anterior end in which a small hole, through which the larva reaches its materials, is left till the last and is then plugged and cemented rather loosely. In one case the hole was not plugged at all, but remained open after the larva had assumed the prepupal position. When the cell is complete, the larva closes the open end and gives the entire inside of the cell a coating of the anal secretion, which is colorless when first applied, but rapidly becomes very dark brown; it then orients itself so that the head end of the pupa shall be opposite the loosely plugged opening; and takes a peculiar prepupal position. The body shortens slightly and the head is bent over and applied to the venter; this fold occurs at the suture between the metathorax and the abdomen. The time taken to become an immobile prepupa is about eighteen hours. The prepupal stage lasts seventeen-eighteen days; but the day before pupation takes place the prepupa raises the head and thorax slightly. The thorax then splits down the back and the pupa emerges.

Pupa: Length 8-10 mm. Color varying with age, but general appearance white. Imago visible through the transparent pupal skin. Spiracles on the second, third, fourth and fifth epipleurites. Genitalia extruded. On the pronotum, an irregular band of fifteen bristles extending distant from the margin along the lateral margin of the thorax to the hind margin half way from center to margin, and an inner row of three bristles. Elytra with scattered bristles, which are definite in number and location. (Pl. XXX, Figs. 1-2). Second, third, fourth, epipleurite each with a stout spine. First and second abdominal tergite with a pair of bristles, third with seven bristles (arranged in a triad and two pairs) each side of middle, fourth with two pairs and fifth with one pair each side of the median line. Propygidium and pygidium fringed with bristles. This chætotaxy is definite in the four specimens before me.

At the end of the second day after pupation the eyes are colored, by the eighth day the median line of the mesosternum and the median line and segment lines of the abdominal tergites

are colored. Pigmentation then commences on the pronotum and after twenty days the pronotum is fully colored. Emergence takes place at the end of from twenty-four to twenty-nine days. In one case emergence started at eight fifty-five in the morning, was completed except for the withdrawing of the genitalia at eleven fifteen, and was fully completed at twelve twenty-five. The adult does not become completely colored for three days after emergence.

Notes on the Morphology of Larva, *H. æqualis*, Last Stage. (Plates XXVIII, XXIX, XXX).

Head: Cranium (Figs. 5, 6, 7) symmetrical, rectangular, a little broader than long; occipital foramen narrower than the cranium and almost directly posterior, the head reaches slightly further back below than above; ventral surface with genal sutures (Fig. 6) apparent in the posterior portion. Labrum (Fig. 3) very rudimentary and slightly differentiated from the clypeus, not movable. Clypeus firmly united to frons, epistoma not distinct. Epicranial and frontal sutures not visible in living larvæ, though slightly visible in moult skins. Antennæ (Figs. 5, 6, 7) deeply inserted in the head. Above the dorsal articulation of the mandible, composed of four segments, the first very short, hardly visible externally, the second long cylindrical, the third capitate, a little more than half as long as the second, the fourth very small, cylindrical, the third joint with a sensory pit at the tip near the external margin, and one to three papillæ near the apex on the internal margin.

Mandible (Figs. 5, 6, 7) falciform, acute, with a single rounded tooth on the inner margin. At the base of the internal margin a cluster of setæ.

Maxillæ (Fig. 7) connected with hypostoma by a thin membrane. Cardo very small, almost completely concealed; a flat plate on the external border of the maxilla and fused to the stipes. Stipes, a long tubular segment, densely fringed with hairs on the inner margin, sparsely fringed on the outer margin, with a long tactile seta near the distal end, inserted just above the margin. The stipes are flattened on the dorsal side. Next to the stipes come a stout short segment, less than one-quarter the length of the stipes. It is swollen on the inner side and bears on the swelling a short finger-like segment,

which has a sensory bristle at the tip. The swollen segment probably represents subgalea and palpifer fused; the finger-like segment is probably galea. At the apex of this swollen segment is a three-jointed palpus. The second and distal segments of the palpus have numerous sensory pits on the surface.

The mentum is coriaceous, colored only on the margins; it is closely united to the submentum, which is slightly chitinized and light brown in color. The palpifers are fused and form a hollow tube, bearing two jointed palpi at the distal end. No ligula or paraglossæ are present. Above the labium lies the hypopharynx. This has two blades, visible in Fig. 7, which bear numerous bristles on the margin. Limiting the hypopharynx on each side is the hypostoma, which extends as a heavily chitinized rod upwards from the base of the mouth cavity, a flattened bridge, the epipharyngeal bracon (Fig. 7), extends between the two rods below the epipharynx (Fig. 3).

The thoracic segments are sharply differentiated from the abdominal. Pronotum consists of a heavily chitinized scutum, a less heavily chitinized parascutum. The meso- and metathorax show the scutum above. The first abdominal segment has a prescutum, a scutum and postscutum, the remaining abdominal segments have the scutum divided into two parts by a line of ambulacral hooks (reptoriæ Schiodte). On all the segments except the prothorax the pleuræ are readily distinguishable. On the dorsal side they are limited by muscle marks and on the ventral side there is a distinct sterno-pleural groove. The pleuræ are divided into epi- and hypopleuræ by the pleural suture. The epipleura of all the segments except the pro- and metathorax bears a biforian spiracle, and a bristle, the hypopleura bears also a single bristle. Prosternum consists of a triangular sternum and two plates on each side of it. The inner one is the parasternum, the outer is pleural in origin. The abdominal sternites show a presternum, a sternum which is cut off from the presternum by a muscle groove and a sternellum which is separated from the other two plates by a row of ambulacral hooks. The ninth abdominal segment bears an anal pseudopod, which I believe to be a tenth segment.

EXPLANATION OF PLATES—SECTION I.

PLATE XXVIII.

Fig. 1. Dorsal view of the larva of Hololepta æqualis Say.
Fig. 2. Ventral view of the larva of Hololepta æqualis Say.
Fig. 3. Underside of the clypeus showing the epipharynx (larva of H. æqualis).

PLATE XXIX.

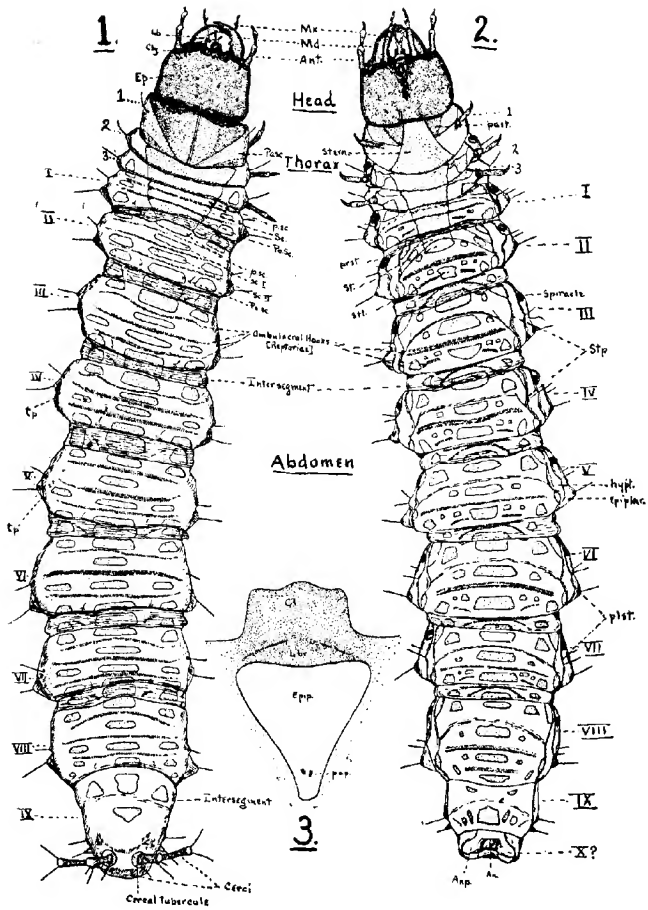
Fig. 4. Lateral view of the larva of H. æqualis.
Fig. 5. Dorsal view of cranium.
Fig. 6. Ventral view of cranium.
Fig. 7. Half front, half ventral view of mouth. Hypostoma and epipharyngeal bracon shown in stipple.

PLATE XXX.

Fig. 1. Ventral view of the pupa of H. æqualis.
Fig. 2. Dorsal view of same.
Fig. 3. Egg of Hister obtusatus Harris. × 12.
Fig. 4. Ovaries of Saprinus pensylvanicus Payk.
Fig. 5. Labium of *H. æqualis*.
Fig. 6. Ovary of Hister obtusatus Harris.

EXPLANATION OF TERMS USED ON PLATES XXVIII—XXIX.

Mx—Maxillae.
Md—Mandibles.
Ant—Antennae.
Lb—Labium.
Cly—Clypeus.
1, 2, 3—Thoracic segments.
I–IX—Abdominal segments.
Pasc—Parascutum.
p. sc—Prescutum.
sc—Scutum.
po. sc.—Postscutum.
past—Parasternum.
prst—Presternum.
st—Sternum.
stl—Sternellum.
stp—Sterno-pleural fold.
plst—Pleural suture.
hypl—Hypopleurite.
epipleur—Epipleurite.
Lbr—Labrum.
Epip—Epipharynx.
pap—Papillae.
F—Frons.
Epic—Epicranium.
Ge—Genae.
lbp—Labial palpus.
Palpig—Palpiger.
Buc. Op—Buccal opening.
hyph—Hypopharynx.
hypst—Hypostoma.
pleur—Pleurostoma.



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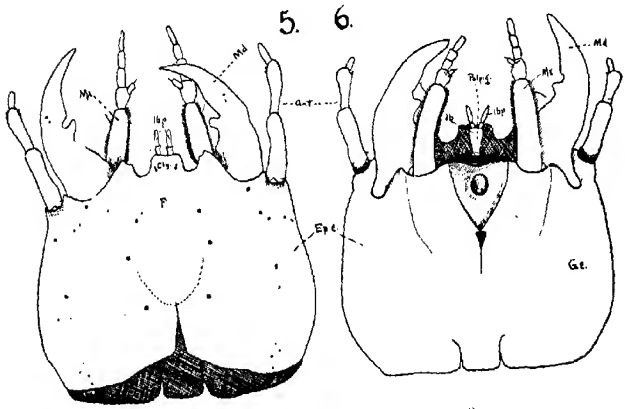
5. 6.



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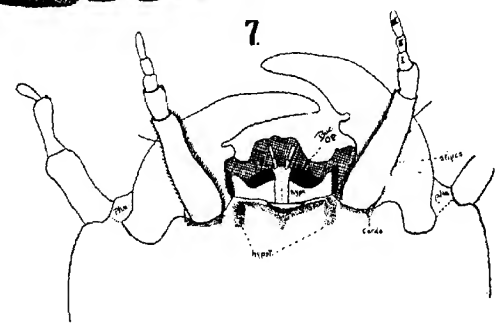

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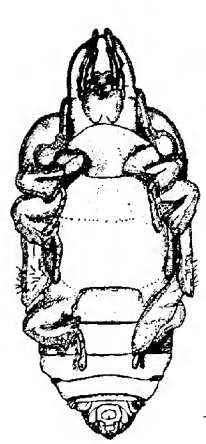

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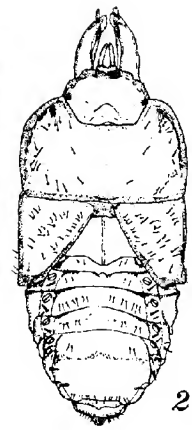

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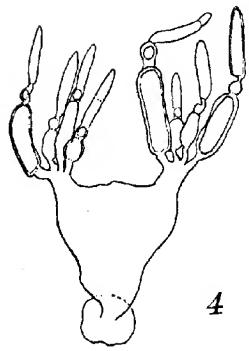

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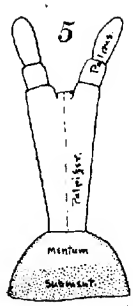

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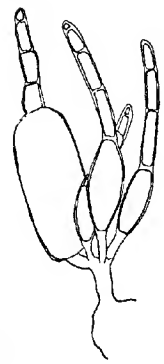

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F. G. Carnochan.

SECTION II.

The species of *Hololeptinæ* are all black, elongate and more or less flattened, with a large projecting head which is more or less retractile, but not depressible; the mandibles are long and projecting, subequal and not crossing, except in *Oxysternus*, in which the left mandible is longer than the right and crosses it when closed. Labrum short, arcuate on each side of the median notch, viewed from above; excavated in front from below; closes the mouth by being applied to the anterior edge of the mentum, into the emargination of which it exactly fits; the maxillæ are inserted behind the mentum, their palpi lying in grooves on the mandibles. The prosternum is unlobed, although in certain of the genus *Hololepta* there is an impressed line dividing the prosternum into two parts, the anterior of which simulates a lobe. The propygidium is horizontal, or slightly depressed.

KEY TO THE NORTH AMERICAN HOLOLEPTINAE.

Prosternum not carinate, rounded or truncate anteriorly. Teeth on middle and hind tibiae unequally spaced, the two lower arising from the same process, more distant from the upper than from each other .Genus **Hololepta**
Prosternum flattened, broadly rounded anteriorly.....Subgenus **Hololepta**
Prosternum elevated, narrower at apex and often truncate..Subgenus **Leionota**
Prosternum carinate, terminating apically in a sharp point. Teeth of hind and middle tibiae, rising from different processes, equally spaced, long, spiniform ..... **Iliotona** n. g.

Genus **Hololepta** Payk.

Elongate, flattened. Head porrect, mandibles subequal. Tibiæ dentate, the anterior quadri-, posterior and intermediate tridentate, the two lower teeth of the intermediate and posterior tibiæ borne on the same process, closer to each other than to the upper tooth; on the intermediate tibiæ there is also, in some species, a small additional tooth at the base of the upper and middle crests.

SUBGENUS HOLOLEPTA.

Strongly depressed, elongate. Prosternum very broad and flat; anterior margin broadly rounded. A fovea-like impression behind the eyes; supraorbital stria entirely lacking. In our forms there is always a transverse line on the prosternum about one-third of the distance from apex to base.

KEY TO HOLOLEPTA.

1. Elytra without entire striae; prosternal apex slightly emarginate; lateral pronotal punctures sparse, indistinct or absent ..... 2.
   Elytra with an entire stria; prosternal apex broadly and evenly rounded; lateral pronotal punctures coarse, in a distinct band..... **lucida** Lec.
2. Elytra without an apical appendix to second stria, tristriate; pygidial punctures large; inflexed portion of elytra not rugose; prosternum not punctate ..... **aequalis** Say.
   Elytra with an apical appendix to the second stria, bi- or tristriate; pygidial punctures fine and sparse; inflexed portion of elytra slightly rugose; prosternum finely punctate..... 3.
3. Narrowly oblong, almost parallel; upper surface impunctate, (except under extreme magnifications); propygidium not bifoveolate..... **populnea** Lec.
   More narrowly oblong than preceding; upper surface distinctly punctate with minute punctures; propygidium bifoveolate at apex. .var. **punctata** nov.

Hololepta æqualis Say. Trans. Amer. Phil. Soc. V, p. 47. 1825.
fossularis Say. Trans. Amer. Phil. Soc. V., p. 47. 1825.
fossularis ♂ Mars. Mon. p. 147, t. 4, fig. 5. 1853.

Elongate, oblong, almost parallel. Front flat, smooth, without striæ; preocular tooth not prominent. Mandibles as long as the head (♂), slightly shorter (♀), stout. Pronotum very slightly bisinuate at base, with a median longitudinal stria half extending from base half way to apex; marginal stria strong, entire, slightly sinuate behind the middle; sides of pronotum distantly and sparsely punctate, distant from margin. Elytra the width of pronotum, narrowing slightly posteriorly; tristriate, the first stria about one-third the length of the elytra, the second about one-third the length of the first, the third a trace, sometimes barely visible; sub-humeral deep, almost reaching the base, abbreviated at apex on the apical sixth. Inflexed border of the elytra impunctate. Propygidium smooth on disk, laterally bordered with sparse, coarse punctures. Pygidium usually evenly, rather sparsely punctate, but occasionally varying to smooth at middle and apex. Mentum transversely concave (♂), slightly concave with the center raised (♀), sparsely punctate. Gula with a broad V-shaped excavation (♂), with a small impressed V (♀). Prosternum broad, apex truncate, margin slightly emarginate. Length (apex of thorax to apex of suture*) 5–6 mm.

Variant forms. Three specimens in my series vary from the typical form by the presence of a very short apical appendix to the first stria.

New York to Michigan and Eastern Kansas, south to Florida, Texas and Louisiana.

*This system of measuring, which gives a constant measure, and is not affected by the retractility of the head and propygidium, will be used throughout this paper.

The amount of punctation on the margins of the thorax varies from a very few distant punctures to an appreciable number, always, however, distant from the lateral margin.

The males may be readily distinguished from the females by the large fossa at the anterior angles of the thorax.

This species occurs under the bark of dead *Liriodendron* and is reported by Marseul to occur under the bark of *Robinia pseudo-acacia*.

It is rather unfortunate that the name *æqualis* must be substituted for the well-known name *fossularis*, but our present laws of nomenclature take cognizance of page priority and the name *æqualis* stands first on the page. Marseul, who first detected the fact that *æqualis* and *fossularis* were opposite sexes of the same species used the male name as was the custom at that time, but in this case also the International code is definite and the earlier name must be used.

Hololepta lucida. Leconte, J. Mon. p. 7, pl. 1, fig. 2. 1845.
Marseul, Mon. p. 177, pl. 4, fig. 18. 1853.

Elongate oblong, almost parallel. Front flat, without striæ; preocular tooth not prominent. Mandibles as long as head (♂) or slightly shorter (♀), stout. Pronotum very slightly bisinuate at base, with a median longitudinal stria extending half way from base to apex; marginal stria strong, entire, slightly sinuate behind the middle; distinctly punctate laterally in a broad band, in which the punctures often coalesce to form vermiform punctures. Elytra the width of the pronotum at base, slightly arcuate; tristriate usually, the first stria entire, the second short, with or without a short apical appendix, the third punctiform or absent; subhumeral abbreviated at base and apex. Inflexed border of elytra impunctate. Propygidium smooth on disk, laterally bordered with extremely coarse, sometimes vermiform punctures, bifoveolate at apex. Pygidium coarsely, densely punctate. Mentum transversely concave (♂), slightly concave with center elevated (♀), very finely, sparsely punctulate. Prosternum broadly evenly rounded at apex. Length 4.5–6 mm.

New York to Southern Illinois, south to Virginia.

The form with the short apical appendix to the second stria is the form described by Leconte. The males may be recognized by the fossa in the anterior angles of the thorax.

Reported by Blatchley (1910) under cotton wood bark.

Hololepta populnea Leconte. Ann. Lyc. N. York, V., p. 163. 1851.
bractea Er. Marseul. Mon. p. 157, t. 4, fig. 15. 1853 (in error).
populnea Marseul. Mon. p. 562, pl. II, fig. 5. 1850.

Narrowly oblong, nearly parallel. Front without striæ, preocular tooth short. Mandibles as long as the head (♂) or slightly shorter (♀). Pronotum bisinuate at base, with a more or less lightly impressed median stria, extending half way from base to apex; marginal stria entire, strong slightly sinuate behind middle, or interrupted or with the entire posterior half lacking. Elytra the width of pronotum at base, parallel; bi-or tri-striate, the first stria short, about one-third the length of elytra, second shorter, one-half the length of the first with a short apical appendix, third punctiform or absent; subhumeral stria deep, abbreviated slightly at base and apex. Inflexed border of elytra slightly rugose. Propygidium smooth on disk, extremely sparsely punctate laterally with deep punctures. Pygidium very finely and sparsely punctulate. Mentum concave (♂), less concave (♀), sparsely punctulate; gula with a broad V-shaped excavation, which has a short longitudinal carina at the base (♂) or with a small V-shaped impression (♀). Prosternum broadly emarginate at apex, finely punctulate. Length 3.5–5 mm.

Utah, Arizona, southern California and New Mexico.

Variants. The typical form as described by Leconte has the marginal stria of the thorax entire, and all the Leconte types have such a marginal stria; many of the specimens which I have examined have the stria more or less interrupted; in the extreme form the posterior half of the stria is absent; every possible intergrade is present in my series, even one in which the stria is broadly interrupted on one side and strong and entire on the other.

The length of the apical appendix also varies, in some it is extremely short and in one it is connected to the second by two punctures. The propygidial sculpture also varies, usually in proportion to the length of the apical appendix, but the correlation is not perfect.

One specimen agrees fairly well with Marseul's description of *H. bractea* Erichson in having the appendical stria directed towards the first stria and in pygidial sculpture. Marseul, in his first description (1853) of *bractea* reported it from the United States, and placed *populnea* in synonomy with it. He had at that time not seen the type of *bractea*. In a later description (1860) made after he had seen the type *bractea*, and had received specimens of *populnea* from Leconte, he states that the two species are distinct. "I hesitate to assign the

specimens above mentioned to *bractea*, because of the recorded variation in the punctation of the propygidium, and the fact that in size and facies the specimen is *populnea*.

The males may be distinguished by the notch in the anterior angle of the thorax, and the greater excavation of mentum and submentum.

Reported by Leconte (1851) under poplar bark; by Horn (1873) between the layers of cotton-wood bark.

Hololepta populnea var. **punctata** nov.

More narrowly elongate than *populnea*, almost parallel. Front without striæ, punctate with fine punctures, preocular tooth short depressed. Mandibles shorter than head (♀) (♂). Pronotum bisinuate at base, with a slightly impressed median stria extending half way from base to apex; marginal stria entire not strongly impressed, slightly sinuate behind middle, or interrupted; distinctly punctate with punctures of same magnitude as those on front and mandibles. Elytra the width of pronotum at base, narrowing slightly towards apex, bistriate, the first stria short, about one-third the length of the elytra, second half the length of the first, with an appendix in the apical third; subhumeral stria abbreviated at base and apex. Inflexed border of elytra slightly rugulose. Propygidium minutely, distantly punctulate on disk, laterally bordered with sparse larger punctures, which are larger than those of *populnea*, slightly bifoveolate apically. Mentum, gula and prosternum as in *populnea*. Length 4 mm.

Arizona, one male and one female. W. M. Mann. Sexes are differentiated as in *populnea*.

Hololepta (Hololepta) **excisa** Mars.

This species is recorded from the United States by Marseul. I have seen no specimens taken in the United States, and do not believe that this species occurs north of Mexico. It is reported from Mexico(Marseul, Biologia), Costa Rica (Biologia), Venezuela, New Granada, and Brazil (Marseul), I append an abstract of Marseul's description.

Oblong, subdepressed, shining black. Front flat, without striae or tubercles. Pronotum punctate laterally, marginal stria scarcely angulate, well marked. The inflexed border of the elytra strongly rugose; subhumeral stria strong, rugose, a little abbreviated at base; dorsal striae two, rudimentary. Propygidium bordered with distant punctures. Pygidium densely and strongly punctate. Anterior tibiae armed with four blunt teeth; posterior with three long spines.

The males are characterised by the excavation of the mentum and the notch in the anterior angle of the pronotum.

Hololepta bractea Erichson, Klug's Jahrb. Ins., p. 91. 1834.
Marseul, p. 157, t. 4, fig. 15. 1853.
Marseul, p. 591 (t. 11, fig. 4). 1860.

In connection with the earlier description Marseul lists this species from the United States, because he had confused the species with *populnea* Lec. Lewis, in his Catalog of the Histeridæ (1905) cites this species from California, evidently on the strength of Marseul's first description, and makes no mention of Marseul's second description which refers the species to New Granada. Bickhardt in Junk's Catalogus Coleopterorum, *Histeridæ*, (1910) copying from Lewis, makes no change in the record or addition to the reference. I doubt the occurrence of this species in the United States.

Hololepta complanata P. deBeauv. Ins. Af. et Am., p. 176, t. 6, fig. 5, 1807.
Lew. Ann. Nat. Hist. XVI, p. 206. 1885.

Lewis and Bickhardt record this species as from North America, a form of citation which usually means north of Mexico. The species was recorded originally from Santo Domingo, and is unidentifiable in North American material.

SUBGENUS LEIONOTA.

Subdepressed, elongate. Prosternum elevated, more or less compressed laterally, narrowed, and anteriorly truncate or rounded at apex. Impression behind the eyes not distinctly limited; supraorbital stria usually visible at base.

The two subgenera of Hololepta are not very well limited, and in many cases a species might be placed with equal propriety in either.

KEY TO LEIONOTA.

1. Pronotum with a short impressed line on each side of the emargination at the apical margin, behind the eyes. Larger species.....2.
Pronotum without a short impressed line on each side of the emargination. Smaller species.....4.
2. Broadly oblong. First and second elytral striae not continued towards scutellum along basal margin. Sternites of abdomen punctate at sides only. Lower crest of fore tibiae not dentate.....3.
Narrowly oblong. First and second elytral striae continued along basal margin almost to the scutellum, this stria occasionally interrupted. Sternites of abdomen punctate throughout. Lower crest of fore tibiae dentate .....**pervalida** Blais

3. Pygidium densely and coarsely punctate. Usually with an appendix to the second elytral stria.....**yucateca** Mars.
Pygidium finely punctate. Never an appendix to the second stria.....
princeps J. Lec.

4. Sides of thorax moderately coarsely punctate. Mentum without an M-shaped excavation.....5.
Sides of thorax impunctate. Mentum with an M-shaped excavation.....7.

5. Front without strioles, or the strioles short, feeble and widely separated. Species broadly oblong.....6.
Front with at least two closely approximated, long arcuate striae. Narrowly oblong.....14.

6. Front without strioles. Larger 6.5–7 mm.....**vernicis** Casey.
Front with widely separated, short, feeble strioles. Smaller 5.5–6 mm.
sirpus sp. nov.

7. Second dorsal stria of elytra interrupted in the basal third..**interrupta** Mars.

8. Elytra with a stria on the basal margin more or less deeply impressed, besides the two dorsal striae.....9.
Elytra with but the two dorsal striae.....**quadridentata.** 10.

9. Elytron with a deeply impressed, transverse stria along the basal margin equidistant from the second longitudinal stria and the scutellum.....
decimstriata sp. n.
Elytra with an area, roughened by three longitudinal lines, between the second dorsal stria and the suture. From this area, a very faint finely impressed line extends along the base almost to the scutellum. On each side of the scutellum is a narrow, deep fovea.....**bifoveolata** sp. n.

10. Front with two shallow foveae. Supraorbital stria long, reaching almost halfway to the tip of the preocular spine. Head extremely minutely punctulate* .....subsp. * **platysma** Er.
Front without foveae, supraorbital stria short.....11.

11. Propygidium not at all, or extremely sparsely punctate on disk. Males with the thoracic fossa deep, and well marked.....12.
Propygidium distinctly punctate on disk. Males with the thoracic fossa poorly developed and very shallow.....subsp. **minor** nov.

12. Pygidium evenly punctate, the space enclosed by four punctures equal in size to a puncture. First elytral stria closer to the second than to the margin.....13.
Pygidium unevenly punctate, the space enclosed by the four punctures being less than half the size of a puncture. First stria midway between second and margin.....*subsp. **quadridentata**

13. Marginal stria of thorax without sinuation.....subsp. **floridae** nov.
Marginal stria of thorax with a shallow semi-circular sinuation just before the middle, and below this on the margin itself a short impressed line..
floridae var. **striatifera** nov.

14. Gula with a carina on each side extending backwards from the mandible, elevated in the anterior half, low and interrupted in the posterior half, the two carinae forming a V. Prosternum narrowly truncate at apex. **vicina.** 15
Gula without carinae, but with a Y-shaped groove. Prosternum broadly truncate, its anterior margin elevated and rugulose.....**caseyi** sp. n.

15. Larger 6 mm. Second, third and fourth abdominal sternites punctate for their entire width.....subsp. **neglecta** Blaisd.
Smaller 4.5–5 mm. Second abdominal sternites punctate at sides only, third and fourth punctate in a narrow band across the middle of disk.....16.

16. Third elytral stria a puncture.....**vicina** Lec.
Third elytra stria as long as the first.....**vicina** var. **californica** nov.

*Denotes a form not occurring in the United States.

Hololepta (Leionota) princeps. Lec. J. Proceedings Acad. Nat. Sci. Phil., p. 310. 1859.

Marseul, Mon., p. 605. 1860.

Horn. Pro. Amer. Phil. Soc., p. 274. 1873 (in error).

Oblong, rather broad. Front without strioles or depressions; preocular tooth slightly prominent, depressed, supraorbital stria long, distinct. Mandibles slightly longer than head, not striate at base; stout. Pronotum strongly bisinuate at base, with a fine median longitudinal stria extending from the base slightly past the middle; marginal stria entire, rounding the anterior and posterior angles, rather sharply broadened in the anterior half; two short striæ near the anterior margin behind the eyes. Elytra the width of pronotum at base, arcuate on the sides, slightly longer on the suture than the median length of the pronotum; apical angle broad and rounded; bistriate, the first stria short, about one-fourth the length of the elytra, the second very short, without a trace of an apical appendix; subhumeral abbreviated at base and apex. Inflexed portion of elytra rugose. Propygidium impunctate on disk and apex, laterally bordered with a narrow band of punctures which are of two sizes, larger and very sparse on the basal half, finer and slightly more numerous on the apical half. Pygidium finely punctate in an irregular band across the disk, smooth at base and apex, punctures usually separated by twice their own diameter but irregular in distribution. Mentum flat, punctate. Prosternum elevated, truncate at apex. Lower crest of hind tibia not dentate. Length 10 mm.

Distribution. Cahon Pass, California. (Tejon Pass, Cal., Lec.).

This species is distinct from *yucateca*, with which it had been synonomized by Horn (1873), being very much broader, and with the punctation of the propygidium and pygidium sparser and finer. Although *yucateca* occasionally has no apical appendix to the second stria, it is readily separable from *princeps* by the characters given above.

In the Leconte collection in the Museum of Comparative Zoology, there are three specimens, the first of which bears the label *H. princeps* Lec., with the locality Cajan Pass, California. All three specimens are identical. Whether these are the veritable types or not is impossible to say, as the species was described by the elder Leconte, who, so Dr. Schwarz tells me, was accustomed to send his specimens to Count Dejean. Some of his species, however, but which ones we do not know, probably found their way into the collection of his son. I shall consider these specimens as types as they agree with the original description fairly well. The greatest point of

divergence between the specimens and the description is in the punctation of the pygidium; the description states that the pygidium is "sat dense" punctured; it is not as densely punctured as the pygidium of *yucateca*, which Marseul says is "densement et assez fortement ponctué." If one had seen *yucateca*, the term dense, even modified, would not be applied to the punctation of the pygidium of *princeps*, as the punctures are in many places separated by from two to four times their own width.

Hololepta (Leionota) yucateca Marseul, Mon., p. 203, t. 5, fig. 1. 1853.
grandis Marseul. Mon., p. 204, t. 5, fig. 2. 1853.
synonomy Marseul, Mon., p. 606. 1860.
Horn, Pro. Am. Phil. Soc., p. 274. 1873.

Broadly oblong. Front with two extremely slight depressions, which may or may not have very lightly impressed striæ at their bottoms; preocular tooth slightly prominent, depressed, supraorbital stria long, distinct. Mandibles longer than the head (♂) or equal in length to the head (♀), stout, usually with a short stria on the upper surface, near the external margin and base. Pronotum bisinuate at base, with a median, longitudinal stria, more or less lightly impressed, extending from the base past the middle; marginal stria entire, rounding the posterior angle, and terminating in a more or less deep fossa close to and behind the anterior angle, rather sharply broadened anterior to the middle (♂) or gradually slightly broadened (♀); two short striæ near the anterior margin behind the eyes. Elytra bistriate, the outer strong, deeply impressed, usually about one-third the length of the elytra, second shorter, usually with an apical appendix of varying length; subhumeral stria abbreviated at base, slightly abbreviated at apex. Inflexed portion of elytra rugose. Propygidium with disk smooth, laterally punctate with a band of moderately coarse punctures which are coarsest near the base; apex very finely punctate. Pygidium densely and coarsely punctate, punctures separated usually by less than their own diameter. Mentum slightly concave, punctate. Prosternum truncate at apex, elevated, punctulate. Ventral segments of abdomen punctate at sides only. Lower crest of fore and hind tibiæ not dentate. Length 8–10 mm.

Distribution. Southern California, New Mexico, Arizona and Texas.

Variants. This species may have the second stria entire, more or less widely interrupted, or with the apical appendix reduced to a very faint line, a series of shallow punctures, or entirely lacking.

The supraorbital stria may be narrowly interrupted at about its middle. The punctation at the sides of the pygidium may coalesce to form a well defined stria of varying length, depending on how many punctures are involved. This stria is always near the base of the pygidium.

The males are usually but not always narrower, and more elongate than the females; their mandibles are longer in proportion to the length of the head, and the thoracic marginal stria is more strongly dilated in the apical half. The length of the stria appendicular is not correlated with sex, and *yucateca* and *grandis* while opposite sexes, are not so because of the length of the appendicular stria, but because of their shape. *Yucateca* is probably the female and *grandis* the male, contrary to what Horn says.

This species is reported from decaying Cereus; in the fruits of Cucurbita, *Echinocactu viridescens*, and in the leaves and stalks of *Opuntia occidentalis* (Fall, 1901).

Hololepta yucateca is very variable and the species as now accepted may be made up of several different elements. Facies, length of mandibles, supraorbital stria, sculpture of front, length of subhumeral stria, length of second stria and its appendix are all variable, but I have been unable as yet to find correlations in any of these characters. The form which has no apical appendix to the second stria closely resembles *princeps* of Leconte in size and facies, but is easily separated from the latter by the punctation of the pygidium.

Hololepta (Leionota) pervalida Blaisdell Zoe III, p. 327. 1892.
Hololepta pervalida Lewis, Ann. Nat. Hist., XIV, p. 139. 1904. (to consider *pervalida* a Mss. name).
pervalida Lewis Catalog., p. 3–5, 1905.
pervalida Schaeffer, Ent. News, XVIII, p. 301, 1907.
pervalida Lewis, Ann. Mag. Nat. Hist., XX, p. 96. 1907.

Narrowly oblong. Front with two mammiform elevations which are delimited by a fine impressed line, deepest at apex, behind the mandibles. In the basal portion of the delimiting line on each side lies a stria which is composed of a series of punctures, and posterior to the stria is a sparsely punctured area which extends across the front, weakest in the center. At the apex of the front in the groove between the elevations there is a small tubercle in the male. Preocular tooth strong, slightly depressed. Supraorbital stria distinct, of varying length, often interrupted. Mandibles stout, carinate, upper margin

carinate, broadly curving, as long as the head. Pronotum slightly bisinuate at base, with a strongly impressed median dimidiate longitudinal stria; marginal stria strong, extending around posterior angles, sharply broader anterior to the middle and terminating in a large fossa (♂), gradually widening and terminating in a small fossa (♀), at some distance behind the anterior angles; anterior to the fossa, the surface of the pronotum is rugose and from this rugose area, a fine stria extends along the anterior margin to a point behind the eye; posterior to this stria there is a short broadly impressed stria, which extends beyond the marginal about one-half its own length; margin of pronotum with the marginal stria irregularly punctate, most densely just posterior to the fossa, the punctures more sparse posteriorly and extending along the posterior margin half way to center. Elytra bistriate, the first short, about one-third the length of the elytra, continued along basal margin to the second, with which it sometimes connects, continued to the apex by a series of distant punctures; the second stria entire, and continued along basal margin of elytra almost to the scutellum; subhumeral deep, abbreviated at base under humerus, but sometimes continued almost to the base by a few punctures. Elytra distinctly punctured towards apex. Inflexed portion of elytra rugose. Propygidium coarsely and fairly evenly punctate, most coarsely at lateral margins. Pygidium coarsely but not very densely punctate. Mentum slightly concave, densely, strigosely punctate laterally and at corners, sparsely punctulate at center. Prosternum elevated, constricted in apical fourth, slightly depressed anterior to the constriction, and again elevated at apex, truncate. Ventral segments of abdomen punctate throughout. Lower crest of fore tibiæ dentate. Length 8-9 mm.

Distribution, San Diego, Co., Pasadena, California.

Variants. The second stria of the elytra is not connected with the marginal at base, is punctiform and broadly interrupted.

The males may be told from the females by the shape of the anterior fossæ and the width of the marginal striæ. In the males the fossa has the internal margin sinuate, and the marginal stria broadens suddenly towards the fossæ at about its middle. This broadening of the marginal stria causes the male thorax to look less punctate than the female thorax as part of the band of punctures lies in the broadened portion of the stria. Just before the stria enters the fossa it cuts under the edge of the fossa so that a small tooth projects over the stria, thus causing the inside margin of the fossa to appear sinuate.

Reported to occur in Yucca whipplei (Fall.) and Echinocactus (Blaisdell).

Hololepta (Leionota) vernicis Casey. Ann. N. Y. Acad., VIII, p. 534. 1893.

Lewis, G. Cat., p. 5, 1905 (synon. in error).
Schaeffer, Ent. News, p. 302. 1907.
Bickhardt, Cat., p. 8. 1910 (synon. in error).

Elongate, oblong. Front without strioles; preocular tooth slightly prominent; supraorbital stria very short basal. Mandibles slightly longer than head (♂), or equal in length to head (♀). Pronotum bisinuate at base, with a median, dimidiate, longitudinal stria, lightly impressed; marginal stria entire, deeply impressed, rounding the posterior angles, and ending anteriorly in deep, triangular fossa (♂) or a short hook (♀); punctate sparsely in a narrow band within the marginal stria, the punctures closer and more numerous basally. Elytra bistriate, the first about one-third the length of the elytra, the second about one-half the length of the first, with an appendix extending from the basal fourth almost to the apex; subhumeral stria deeply impressed for most of its length, the basal part fine and reaching almost to the base (♂) or a little shorter (♀). Inflexed portion of elytra rugulose. Propygidium smooth on disk, coarsely punctate laterally, finely punctulate at apex. Pygidium coarsely and densely punctate. Mentum concave (♂), almost flat (♀) evenly punctate. Prosternum elevated, truncate at apex. Ventral segments punctate at sides only. Lower crest of fore and hind tibiæ not dentate. Length 6.5–7 mm.

Distribution, Arizona (type). Huachuca Mts., Arizona (Schaeffer).

Santa Rita Mts., (Schwarz and Barber) Oracle, Arizona.

Variants. One male has a small stria which is attached basally to the appendix of the second stria at an obtuse angle, and so prolongs the appendix that it almost reaches the second stria.

Two specimens have an entire second stria on one side, the other side normal.

The male is slightly broader than the female, has a large deep fossa at the anterior angle of the pronotum, a differently shaped mentum and a longer subhumeral stria.

Reported to occur in dying *Dasyllirion* (Schwarz) and *Agave americana?* (Schaeffer).

Hololepta (Leionota) sirpus sp. nov.

Broadly oblong. Front feebly bistriate, the stria widely separated; preocular tooth moderately prominent; supraorbital stria, basal, short. Pronotum with a lightly impressed median stria extending from base half way to apex; punctate laterally in a narrow band of large, distant punctures; marginal stria entire strong, rounding the posterior angle

and extending to a point opposite the second dorsal stria, ending anteriorly in a triangular fossa (♂), or just turning the anterior angle (♀). Elytra bistriate, the first basal slightly more than one-third the length of elytra, second shorter with an apical appendix which reaches past the tip of the first stria and is curved inward at the base; in addition there is short stria outside the first on the humerus; subhumeral stria abbreviated under the humerus at base, and abbreviated at apex. Propygidium bifoveolate at apex, coarsely, moderately densely punctured on the lateral thirds, finely punctate at apex, disk smooth. Pygidium densely and coarsely punctured. Mentum excavated (♂), almost flat (♀). Prosternum elevated, broadly rounded at apex, with an impressed line at the apical fourth. Length: Male, 6 mm.; female, 5.5 mm.

Type ♀. Ramsey Canon, Huachuca Mts., Arizona (W. M. Mann).

Paratype ♂. Mexico.

Hololepta (Leionota) quadridentata. Fal. Ent. Syst. I, p. 74. 1792.

quadridentata (platysma Erisch.) Paykull. Mon., p. 109, t. 9, fig. 4. Larva t. 1, fig. 3 (in error). 1811.

Marseul. Mon., p. 212, t. 5, fig. 10. 1853. p. 608. 1860.

Perris. Insectes du Pin. Maritime. Col. I. (Larva) 1863, p. 123–124.

H. flagellata. Kirby, Trans. Linn. Soc. Lond. XII, p. 395. 1818.

Lewis, Ann. Mag. Nat. Hist., XV, p. 458. 1885.

H. surinamense. Habst. Kaf. IV, p. 51. 1791.

Oval. Front without strioles; preocular tooth moderately prominent, mandibles as long as head. Pronotum markedly bisinuate at base; marginal stria entire extending around the posterior angles to a point opposite the second elytral stria, deeply impressed, except for the portion on the posterior margin of the pronotum which is fine. Elytra bistriate, the first stria short about one-third the length of the elytra, the second entire, slightly arcuate. Subhumeral moderately deep, rugose, extending from apex four-fifths to base. Inflexed portion of elytra not rugose. Mentum slightly concave with an M-shaped excavation which makes the mentum appear carinate. Prosternum elevated, truncate at apex.[1], [2]

[1]**Hololepta quadridentata** Payk. Mon. p. 109, t. 9, fig. 4, 1811.

Erichson, Klugs. Jahrb. Ins., p. 95. 1834.

Marseul. Mon., p. 212. 1853.

Front with two shallow elongate foveæ, these foveæ divide the head into thirds, and extend longitudinally from the posterior third to the anterior third of the front. (fig. –). Supraorbital stria long, reaching a point almost half-way to the tip of the preocular spine. Front minutely punctate under high magnifications. Pronotum with an extremely

faint median dimidiate stria; surface minutely punctulate under high magnifications. Elytra with the first dorsal stria midway between the second and the margin, second stria evenly arcuate. Propygidium appearing smooth on the disk (under high magnifications extremely finely and minutely punctulate), punctate laterally, the punctures coarse, becoming finer towards base, center, and finest but distinct along the apical fourth. Pygidium evenly, moderately coarsely and not very densely punctate, the space enclosed by four punctures being equal in size to one puncture. Visible portion of dorsal segment anterior to the propygidium coarsely and densely punctate. Length 5.75 mm.

Distribution, Peru and Brazil.

[2]Subspecies **quadridentata** Fab.

Front without strioles or foveæ, noticeably punctate, more densely than in the preceding; supraorbital stria extremely short, extending at most less than one-third to tip of preocular spine. Pronotum punctate, more noticeably so than in the preceding. Elytra with the dorsal striæ almost as in the preceding, but the second dorsal has a slight uneven sinuation opposite the apex of the first dorsal. Propygidium less punctate than the preceding, the punctures more widely spaced, and the apex appears smooth. Pygidium unevenly punctate, the lateral punctures twice as large as in the preceding, and more dense, the space enclosed by four punctures being less than half the size of a puncture; punctation finer and more distant at the center. Visible portion of the segment anterior to the propygidium as in the preceding.

Male with the anterior fossa of the thorax well marked.

Length 5.5–5 mm.

Distribution, Mexico.

Subspecies **floridæ** nov.

Head and pronotum as in *quadridentata* but not more punctate than typical form. Elytra with the first dorsal stria closer to the second dorsal than to the margin; second dorsal as in the preceding subspecies. Propygidium with the punctures distributed as in subspecies *quadridentata*, but more densely punctate laterally, and sometimes with a very few occasional punctures on the disk. Pygidium with the punctures spaced as distantly as in the typical subspecies, but diminishing in size towards the center as in *quadridentata*. Visible portion of the segment anterior to the propygidium with slightly larger but fewer punctures than the preceding.

Male with the anterior fossa of the thorax well developed, and deep.

Length 5–4.25 mm. 13 males, 14 females.

Type, allotype and paratypes in my collection.

Distribution, Enterprise, Indian River, Biscayne, Jupiter, Haulover, Florida.

The three preceding have the propygidium more convex and longer in proportion to its width than the following subspecies:

Subspecies **minor** nov.

Front, and pronotum punctulate as in typical subspecies. Supraorbital stria extremely short, basal, usually a single puncture or punctiform. Elytra with the dorsal stria as in the preceding subspecies. Propygidium punctate as in the preceding laterally, but with some of the discal punctures more enlarged than in the preceding forms. Pygidium as in the preceding subspecies.

Male with the anterior fossa of the thorax very shallow and poorly developed. Both sexes with anterior angles of the pronotum depressed.

Length 4.25–3.25 mm. 6 ♂♂, 16 ♀♀.

Type, allotype and paratypes in my collection.

Distribution, Enterprise, Indian River, Florida and North Carolina.

This sub-species has the propygidium more flattened and shorter in proportion to its width than any of the preceding subspecies. There is a gradual decrease in the size of these subspecies; *platysma*, *quadridentata* and *floridæ* are close together in size, and progressively smaller; *minor* is very much smaller. The measurements given above for *floridæ* and *minor* do not seem to show this, but when the average size of a series is taken it is very distinct. The average size of my series of *floridæ* is 4.75 mm., while the average size of *minor* is 4.2 mm.

Subspecies **floridæ** var. **striatifera** nov.

More narrowly oval than typical *floridæ*. Supraorbital stria moderately well defined but short. Marginal stria of thorax entire, with a very shallow semi-circular sinuation just before the middle; under this sinuation and between the marginal stria and the margin lies a short stria. Propygidium and pygidium as in *floridæ*.

Length 4.75 mm. Type in my collection.

Distribution, Florida.

This species is very variable in the number and spacing of the teeth on the lower crests of the hind and intermediate tibiæ; the commoner forms have this crest with two closely approximated teeth on the middle tibiæ, and one tooth on the hind tibiæ, or two moderately widely spaced teeth on the middle tibiæ and two closely approximated teeth on the hind tibiæ; less often we find the spaced teeth of the middle tibiæ

combined with a single tooth on the hind tibiæ. One specimen has four small teeth on the lower crest of the middle tibiæ and three on the hind; one specimen has the 4-3 condition on one side and the 2-2 condition on the other. Two specimens from Mexico have one tooth only on the lower crest of both hind and middle tibiæ.

It is reported to occur in decaying palmetto (*Sabal*) by Schwarz.

Hololepta (Leionota) decimstriata sp. nov.

Oval. Front minutely punctate; supraorbital stria entirely lacking. Mandibles as long as head, punctulate. Pronotum bisinuate at base with a very faint median striæ, which does not reach the base and extends forward past the middle; marginal stria as in *quadridentata*. Elytra longitudinally tristriate, the first stria short, basal, one-third the length of elytra, second entire, slightly arcuate, third short on the apical sixth; at the base of the elytra there is a short, deeply impressed transverse stria, equidistant from the second longitudinal stria and the scutellum. Subhumeral stria deep, rugose, abbreviated at base, reaching the basal fourth and almost reaching the apex; a series of confused punctures between the apical end of the subhumeral and the apical end of the second stria. Inflexed flanks not rugose.

Propygidium moderately convex, with large punctures laterally which grow finer towards the disk and apex; disk smooth. Pygidium with coarse, moderately dense punctures laterally, which become finer and more distant towards the center and apex.

Mentum as in *quadridentata*. Prosternum with the apex more broadly rounded than in *quadridentata*.

Length 5 mm. Type in my collection.

Distribution, Enterprise, Florida (Beutenmüller).

Hololepta (Leionota) bifoveolata sp. nov.

Oval. Front without strioles; supraorbital stria lacking or very short, punctiform; mandibles as long as the head. Prothorax with the marginal stria deeply impressed, extending around the posterior angles and interrupted slightly anterior to the middle. Just behind the interruption the margin is slightly flattened on the outer surface, producing a very slight emargination when seen from above. Elytra with two dorsal stria, the first strongly impressed, about one-third the length of the elytra, the second less strongly impressed, entire, broadening to a shallow fovea at apex. Subhumeral stria almost as in the preceding but more deeply and narrowly impressed. At a point not quite half-way between the second dorsal and the suture, there is at the base of the elytra a small area, roughened by two or three short

longitudinal lines, from which a very finely impressed line extends along the base almost to the scutellum; on each side of the scutellum on the elytra is a deeply impressed, narrow fovea, into which the light line mentioned above sometimes runs. Propygidium and pygidium as in the preceding. Mentum as in quadridentata. Prosternum broad, elevated, truncate, slightly depressed at the tip, the edges of the depression elevated. Hind tibiæ with the lower crest unidentate, middle tibiæ with the lower crest bidentate, the teeth widely separate.

Length 4 mm. Type and paratype in my collection.

Distribution, Enterprise, Florida.

Hololepta (Leionota) interrupta Marseul. Mon. p. 214, pl. 5, fig. 11. 1853.

Similar in all respects to *Hololepta quadridentata*, sp. *minor*, except that the second dorsal stria is interrupted behind the middle, and the secondary sexual thoracic fossa of the male is rather better developed. Length 1 mm.

Type locality, Cuba. Florida (2).

Two specimens from Florida (♂, ♀), I assign to this species. The male agrees with Marseul's description; the female has the second dorsal twice interrupted, in the basal third and just behind the middle. Marseul states that this species may be told from *quadridentata* by the more lightly punctate pygidium and propygidium, and the "usually" interrupted second stria. He includes this species in his key under the forms which have the second stria entire. The punctation of the pygidium and propygidium of *quadridentata* I have shown to be variable, and I should consider this form to be a variety of *quadridentata* were it not for the fact that when an entire stria is interrupted, the interruption nearly always takes place in the basal third, and the apical portion of the stria becomes shorter progressively. Neither of my specimens shows this condition; the female specimen has an interruption in the basal third, but there is a short stria between this and the more apical interruption. This condition leads me to believe that the apical interruption was the first, and the latter interruption came as it does in a variable stria.

Hololepta (Leionota) vicina Lec. Ann. Lyc. Nat. Hist., N. Y., V. p. 163. 1851.

Narrowly oblong. Front with two semi-circular strioles which may connect to form a single sinuate stria; preocular tooth moderately prominent; supraorbital stria short. Pronotum with a lateral narrow

band of distant punctures, median stria extending past the middle, marginal stria entire, broadening from the anterior third into a shallow fossa behind the anterior angle, posteriorly extending around the posterior angle to a point opposite the second stria of the elytra. Elytra with three stria, the first short, about one-third the length of the elytra, usually continued to the apex of the elytron by a series of punctures, the second entire, third a basal puncture. Propygidium evenly, moderately punctate, the punctures largest laterally, finest on disk and apex. Pygidium densely punctate. On the ventral surface of the head there is extending backward from the base of the mandibles, on the gula a carina much elevated in the anterior half, low and interrupted in the posterior half; the carinæ of both sides form a V, the center of which is evenly excavated (♂), or the posterior half of the carina is obsolete or lacking and the center of the gular plate has a raised boss just behind the mentum (♀). Prosternum narrowly truncate at apex, with a V-shaped slight depression at apex (♂), or not depressed (♀), and very slightly emarginate. Second ventral abdominal segment punctate at sides only; third and fourth distinctly punctate at sides and across middle of disk. Second segment one-third the length of third.

Length 4.25–5 mm.

Distribution, San Diego, Pasadena, Washington, California, Southern California.

Hololepta (Leionota) vicina var. **californica** nov.

Similar in all respects to *vicina* but the third elytral stria is at least half as long as the first stria, though not as deeply impressed. The propygidium is less densely punctate and the punctures are larger and more uniform in size. Length 4.5 mm.

Two specimens labelled S. California (Joutel).

Hololepta (Leionota) vicina subspecies **neglecta**. Blaisdell. III. p. 338, 1892.

Lewis Ann. Mag. Nat. Hist. XIV. p. 139, 1904.
Lewis Cat., p. 3, 1905 (in error).

Narrowly elongate. Front quadristriate; the two usual arcuate striæ are present (as in *vicina*), anterior to these are two short more or less broken striæ, which form with the arcuate stria narrow V's, the apices of which are directed outward (Pl. VI. fig. 2); preocular tooth moderately projecting, depressed; supraorbital stria short, basal. Pronotum with a lightly impressed median stria which extends from the base to the middle; marginal stria entire, extending around the posterior angle to a point opposite the third stria of the elytra, ending apically in a shallow fossa close to and within the anterior angle of the pronotum; a narrow lateral band of punctures inside the marginal stria, most dense at base, very sparse and faint at apex. Elytra tristriate, the

first stria short, basal about one-third the length of the elytra, continued to apex by a series of more or less elongate punctures, second stria entire, third punctiform; subhumeral abbreviated at base and apex. Inflexed portion of elytra slightly punctate in a short band immediately inside the marginal ridge, otherwise smooth. Propygidium punctate rather evenly, the punctures large on sides, smaller on disk and at apex. Pygidium densely punctate. Mentum concave, faintly punctate. Gula as in *vicina*. Prosternum as in *vicina*. Mesosternum sparsely punctulate. Second, third and fourth ventral abdominal segments punctate for their entire width. Second segment one-half the length of the third. Length 6 mm. Type.

Distribution, San Diego Co., Cal. (F. E. Blaisdell).

This description is drawn from the type specimen kindly sent me by Mr. Blaisdell. The species is very close to *vicina*, but is much more elongate and has a very different facies. It differs from *vicina* in the sculpture of the ventral segments, in the more convex pygidium and in the shortness of the elytra, which causes the margin of the third dorsal abdominal segment to be visible for its entire width. The type is, I believe, a male.

Hololepta (Leionota) caseyi n. sp.

Narrower and more elongate than *vicina*. Front bistriate; preocular tooth moderately prominent; supraorbital stria short. Pronotum with a narrow lateral band of punctures; median stria absent or very lightly impressed; marginal stria as in *vicina*. Elytra as in *vicina*. Propygidium coarsely and sparsely punctate, the punctures finer on disk and apex; in a few specimens the disk is almost impunctate. Pygidium densely punctate. Submentum without carinæ and the cup shaped excavation of *vicina* replaced by a Y-shaped groove. Prosternum broadly truncate, its anterior margin narrowly elevate and rugulose (Pl. VI, fig. 1). Second, third and fourth ventral segments punctate at sides, impunctate on disk. Length 4.5 mm.

Holotype and six paratypes. Holotype labelled Arizona, paratypes, Nogales, Arizona.

Genus **Iliotona** gen. nov.

More or less elongate, subdepressed. Head porrect, mandibles subequal. Tibiæ dentate, the anterior quadri posterior and intermediate tridentate. The two lower teeth of the intermediate and posterior tibiæ borne on separate processes, and all three teeth subequally spaced. Prosternum carinate, terminating apically in a sharp point.

KEY TO ILIOTONA.

Pygidium margined. Mandibles without teeth and not dilated at basal fourth. Thorax not grooved near side margin below apical third...**cacti** Lec.

Pygidium unmargined. Mandibles suddenly dilated at basal fourth, with a tooth above the dilation. Thorax near side margin slightly below apical third, with a deep transverse groove.....**beyeri** Schaef.

Iliotona cacti Lec. Ann. Lyc. Nat. Hist. N. Y., V. p. 162. 1851.
Mars. Mon., p. 400, t. 10, f. 5, 1857.
Horn. Pro. Phil. Soc., p. 275. 1873.

Oblong, parallel. Front with two shallow impressions which may contain striæ, or be punctured; supraorbital stria long. Pronotum bisinuate at base with a median longitudinal stria extending two-thirds from base towards apex. Lateral margin of pronotum punctate. Marginal stria interrupted at middle by the lateral punctures on the margin itself in a small flattened area, at the interruption of the marginal stria, a single puncture. Elytra bistriate, the first dorsal short, not reaching the middle, second entire, subhumeral moderately deep, abbreviated at base. Inflexed portion of elytra rugose. Pygidium shining on disk, opaque in a band along apex. Coarsely punctate at sides, finely or not at all on disk. Pygidium opaque, finely, rather densely punctate, the apical portion higher, shining and impunctate, thus giving a margined appearance to the pygidium.

Mentum coarsely punctured, triangularly emarginate, with an elevated line extending from the hind angles to the middle or the emargination on each side. Prosternum elevated, narrow, broadened at base, terminating acutely at apex. Length 4.5–7.5 mm.

Variants. This species is very variable in the secondary sexual characters. Mexican specimens have the fossa of the male as a single deep pit, and the disk of the propygidium in both sexes impunctate and are without frontal striæ, the place of which is taken by punctures. These specimens are also much larger than the types.

Texas specimens in my collection have the fossa of the male divided into two parts, the disk of the propygidium is punctate, and the frontal striæ are replaced by punctures.

The Leconte types from San Diego have the fossa single as in the Mexican form, the propygidium is punctate on the disk, and the frontal striæ are well marked, though short and widely separated.

Distribution, Mexico, Texas, and Southern California.

Iliotona beyeri Schæffer. Ent. News, p. 302. 1917.

Elongate. Head sparsely rather coarsely punctate, a few finer punctures intermixed, preocular spine short, indistinct, supraorbital stria distinct. Mandibles elongate, feebly curved at apex, suddenly dilated on the inner side at the basal third, above the dilation, a single obtuse tooth. Pronotum with an impressed median line extending two-thirds from base to apex; marginal stria entire, at the sides slightly below apical third, a deep sinuate transverse groove, above this

a shorter straight transverse groove, and below it a very short groove which is connected to the large one by the marginal stria; region near apical and basal angles coarsely punctate; disk smooth. Elytra bistriate, first dorsal short deeply impressed, continued to base by a series of fine punctures, second subentire, ending in confused punctures, subhumeral deep, abbreviated at base and apex. Propygidium shining on disk, subopaque at sides and apex, rather sparsely so on disk. Pygidium subopaque, finely, densely, and evenly punctate. Mentum carinate as in *cacti*. Prosternum elevated carinate, broadened at base, terminating apically in a point. Length 8.5 mm.

Santa Rosa, Lower California.

EXPLANATION OF PLATES, SECTION II.

PLATE XXXI.

Fig. 1. Hololepta lucida (♂).
Fig. 2. Hololepta aequalis (♂).
Fig. 3. Hololepta populnea.
Fig. 4. Hololepta (Leionota) decimstriata.
Fig. 5. Hololepta (Leionota) interrupta.
Fig. 6. Hololepta (Leionota) bifoveolata.
Fig. 7. Hololepta (Leionota) quadridentata, ssp. floridae (♂).
Fig. 8. Hololepta (Leionota) quadridentata, ssp. minor (♀).
Fig. 9. Hololepta (Leionota) quadridentata, ssp. floridae (♀).

PLATE XXXII.

Fig. 10. Hololepta (Leionota) quadridentata, ssp. minor (♂).
Fig. 11. Hololepta (Leionota) sirpus.
Fig. 12. Hololepta (Leionota) vicina.
Fig. 13. Hololepta (Leionota) pervalida (♀).
Fig. 14. Hololepta (Leionota) neglecta.
Fig. 15. Hololepta (Leionota) caseyi.

PLATE XXXIII.

Fig. 16. Hololepta (Leionota) quadridentata, ssp. quadridentata.
Fig. 17. Hololepta (Leionota) yucateca, extreme variant closely resembling princeps.
Fig. 18. Hololepta (Leionota) yucateca.
Fig. 19. Hololepta (Leionota) quadridentata, ssp. platysma.

PLATE XXXIV.

Fig. 20. Hololepta (Leionota) pervalida (♂).
Fig. 21. Hololepta (Leionota) vernicis (♂).
Fig. 22. Hololepta (Leionota) vernicis (♀).
Fig. 23. Iliotona beyeri.

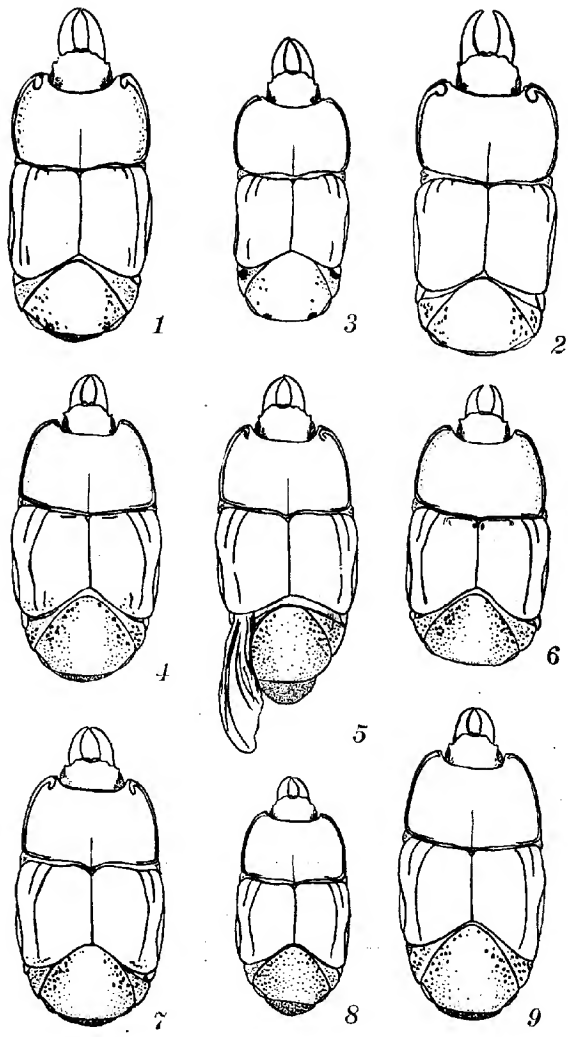
PLATE XXXV.

Fig. 24. Iliotona cacti, Texas form (♀).
Fig. 25. Iliotona cacti, Texas form (♂).
Fig. 26. Iliotona cacti, Mexican form (♂).

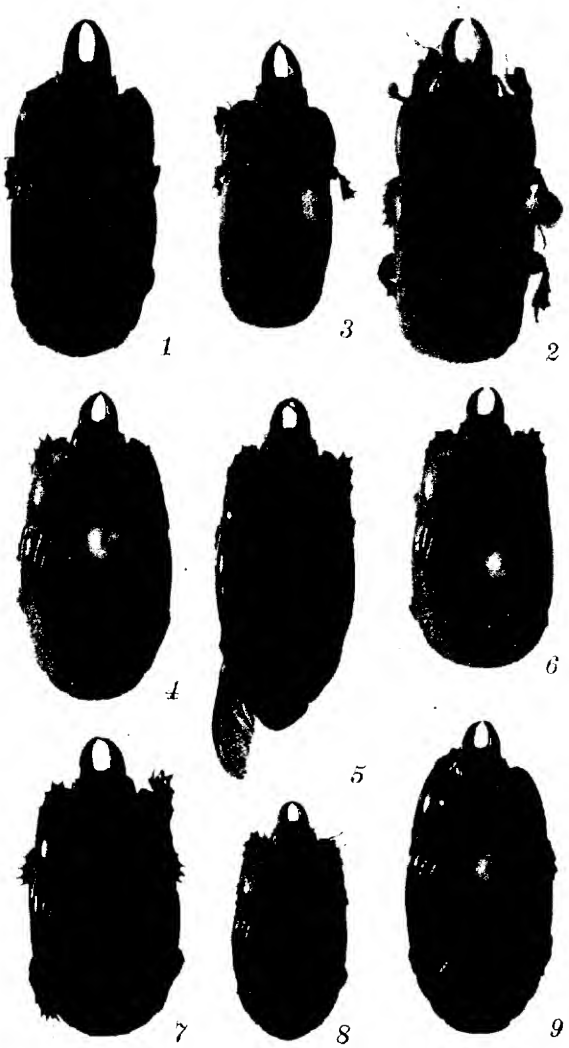
All figures are of the same magnification, about X 8.

PLATE XXXVI.

Fig. 1. Ventral view of head and prosternum of H. (L.) caseyi.
Fig. 2. Ventral view of head and prosternum of H. (L.) vicina.



F. G. Carnochan.



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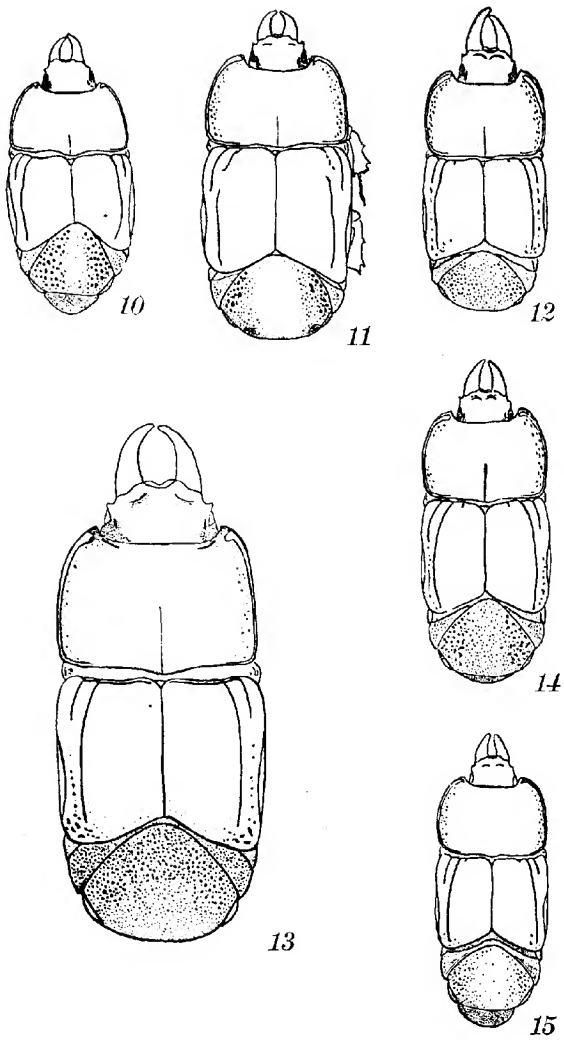

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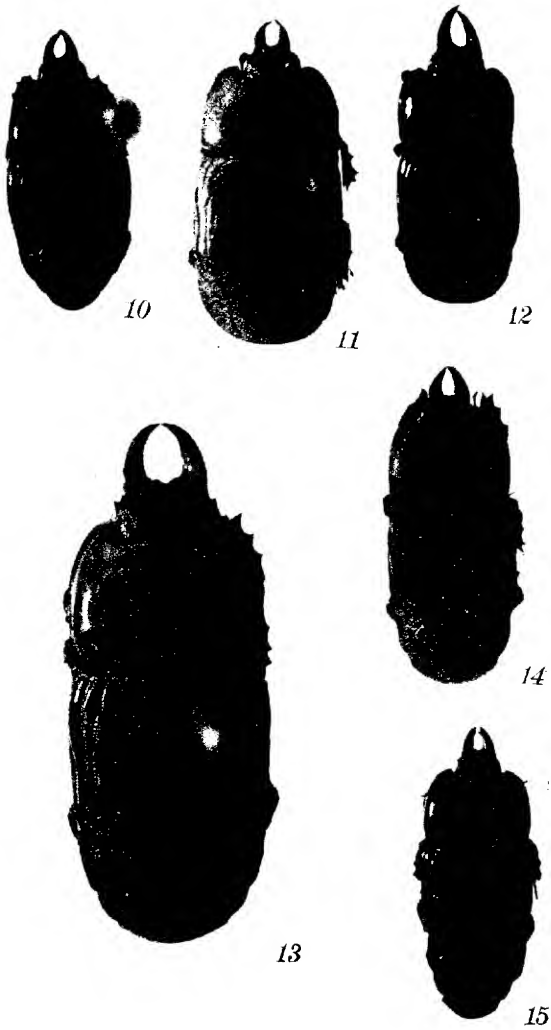

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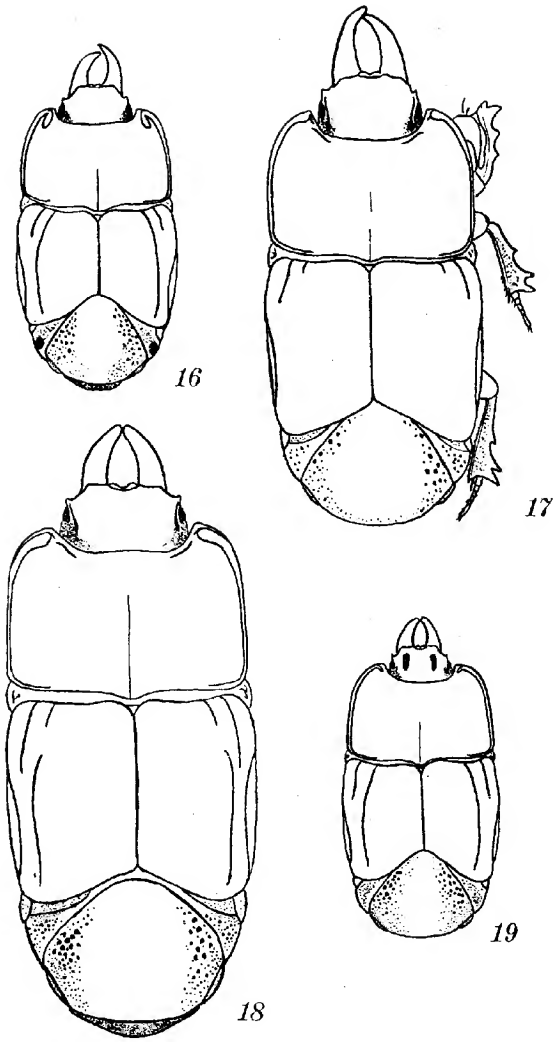

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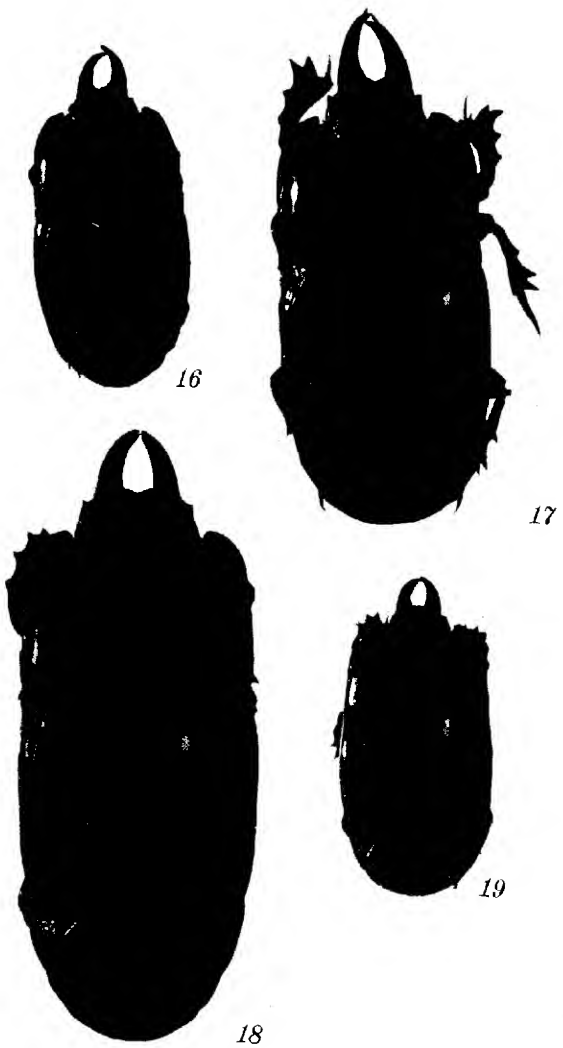

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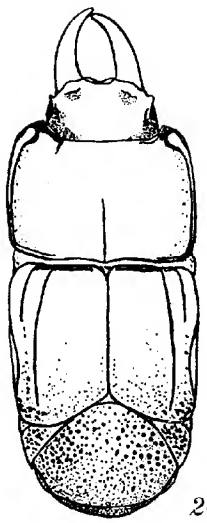

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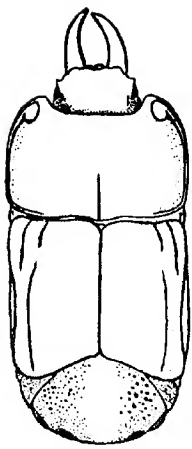

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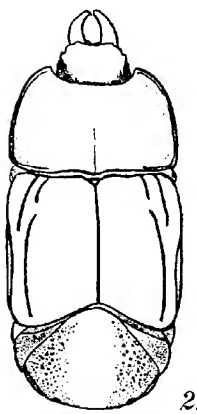

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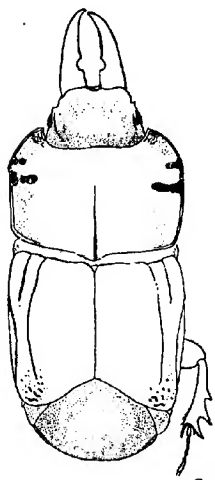

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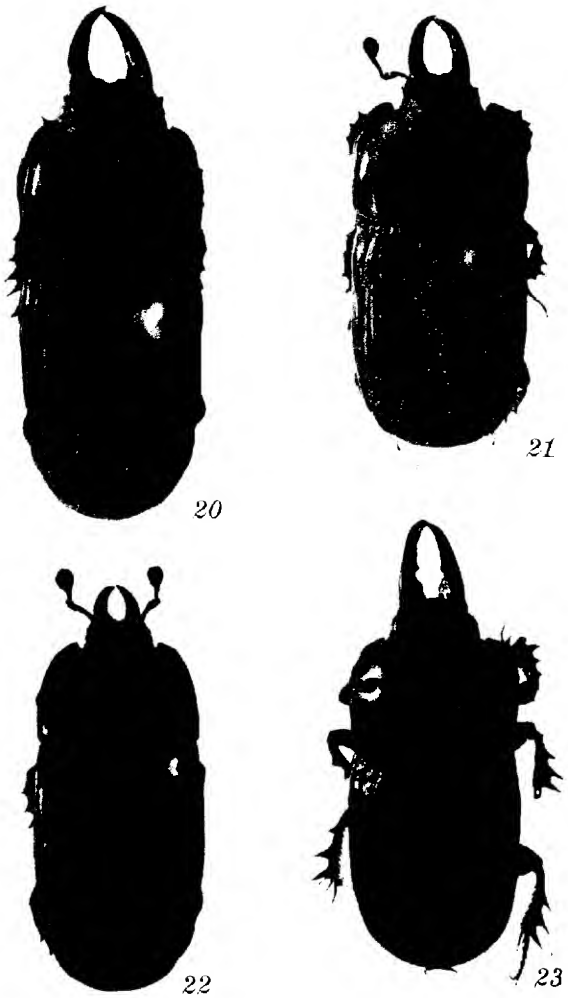
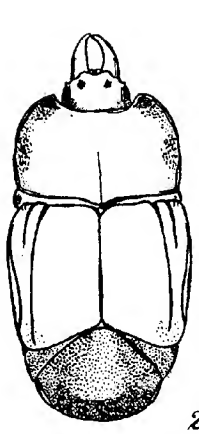
F. G. Carnochan.



F. G. Carnochan.



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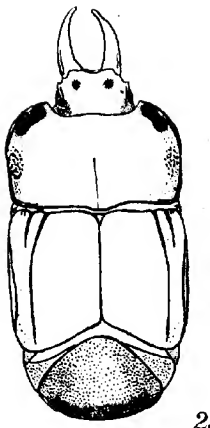

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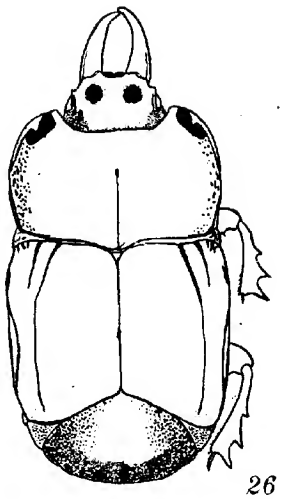

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F. G. Carnochan.

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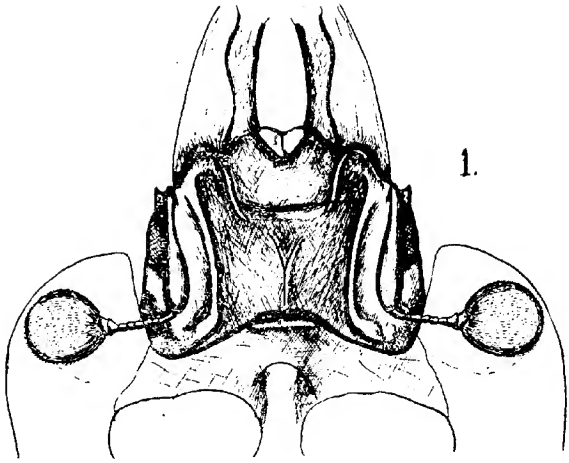
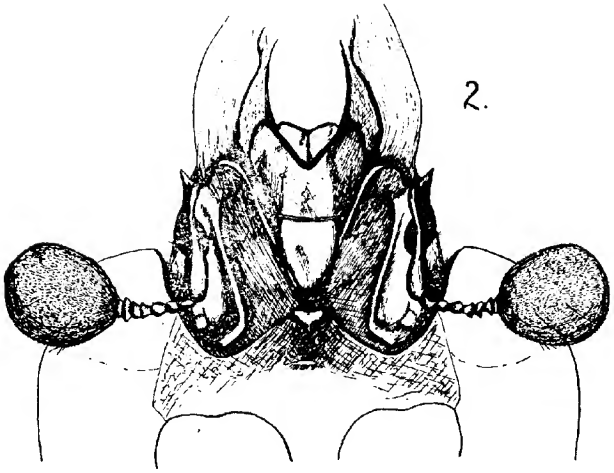
F. G. Carnochan.





F. G. Carnochan.

INDEX OF VOLUME X.

ERRATA.

(For the June number of the "Annals," Vol. X, No. 2).

Page 126.—Figure 1 should be inverted.

Page 127.—The second footnote should read: The descriptions of this species and its genus have been sent away for publication in Part II of my series on "New Acarina."

NOTE:—The long withheld manuscript for Part II, New Acarina, unexpectedly appeared so as to ante date this paper.

PROGRAM

Annual Meeting of the Entomological Society of America, Pittsburgh, Pa., December 28 and 29, 1917

Official Hotel—William Penn

Meeting Place—Assembly Room, Margaret Morrison Carnegie School

FIRST SESSION, DECEMBER 28, 2:00 P. M.

Notes on the Genus Buprestis Linn. in California..RICHARD T. GARNETT
Studies on the Dryinid Parasites of Leaf-Hoppers....F. A. FENTON
Notes on the Body Wall of the Cockroach.....E. H. DUSHAM
Climatic and Seasonal Variation in Cerodonta.....J. M. ALDRICH
Observations on the Life History and Habits of *Pilophorus walshii* Uhl
BENTLEY B. FULTON
The Empid Genus Drapetis.....A. L. MELANDER

SECOND SESSION, DECEMBER 29, 10:00 A. M.

Business Meeting: Reports of Officers and Committees; Election of Officers; General Business.
Notes on the Early Stages and Habits of Botflies.....
SEYMOUR HADWEN and A. E. CAMERON
Annotated List of Lachnesterna Enemies.....J. J. DAVIS
The Bioclimatic Law of Latitude, Longitude and Altitude, as Applied to Entomological Research and Practice...A. D. HOPKINS
A Systematic Study of the Organisms Distributed Under the Name of *Coccobacillus acridiorum* d'Herelle.....R. W. GLASER

THIRD SESSION, DECEMBER 29, 2:00 P. M.

Distribution of the Maritime Diptera of Eastern North America..
C. W. JOHNSON
A Contribution to a Knowledge of the Life-History of the Leaf-eating Crane-fly, *Cylindrotoma splendens*.....A. E. CAMERON
Reminiscences of My Early Work upon the Diptera.....
S. W. WILLISTON, Honorary Fellow
The Hickory Gall Aphid and Its Control.....HUGH GLASGOW
Notes on the Genus Chlorotettix.....D. M. DELONG
Some Comparisons in the Coccid Genus Chionaspis and Related Genera ..... A. H. HOLLINGER
The Coccidæ of Cuba.....J. S. HOUSER
The Alydinæ (Heteroptera) of the United States.....S. B. FRACKER

FOURTH SESSION, DECEMBER 29, 8:00 P. M.

Annual Address.....PROFESSOR VERNON KELLOGG

The Executive Committee will meet at the William Penn Hotel at 10 A. M., December 28th. The Thomas Say Foundation will meet at the William Penn Hotel at 9 A. M., December 28th.